Measuring Resting Metabolic Rate and its Benefits for the Guests of the Hilton Head Health Institute

An Honors Thesis (HONRS 499)

By

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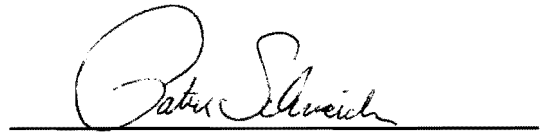

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ABSTRACT

The Hilton Head Health Institute (H^3I) offers their guests the option of purchasing a Metabolic Assessment through the indirect calorimetry method. This provides the guests with a personalized "metabolic fingerprint" which then allows the professionals at the Institute to come up with a more personalized weight loss plan that will provide better long-term benefits. The meal plan the guests are placed on during their stay at the Health Institute is based on twelve-hundred kilocalories. For many people, this should be considered an aggressive dieting phase of weight loss, and should only be maintained for a maximum of four to six weeks. By assessing an individual's resting metabolic rate and their current activity level, an exercise and meal plan can be developed in order to keep the individual in a "weight loss" or "weight management" state (according to their goal), preventing a plateau.

In order to support the idea of offering the Metabolic Assessment to the guests of the Hilton Head Health Institute, I give an overview of literature on the benefits of knowing an individual's resting metabolic rate, what effects the metabolic rate, and a data analysis comparing the measured resting metabolic rate (RMR) with an estimated RMR and other health-related factors.

Acknowledgements

- I want to thank Dr. Schneider for his support and advice throughout the process of creating this project. He always helped me in a friendly and timely manner.

- I would like to thank Mr. Bill Theirs, V.P. and CFO of the Hilton Head Health Institute for helping me understand the statistics I was able to derive from the given data.

- I would also like to thank Mr. Bob Wright, Director of Lifetime Education, and Ms. Lauren Wilson, Fitness Coordinator of the Hilton Head Health Institute for spending time with me to explain the process of administering the Metabolic Assessment to the guests, determining the results, and putting the results into a form the guests are able to use and understand.

OVERVIEW

What is Resting Metabolic Rate (RMR)?

The resting metabolic rate is the minimum caloric requirement needed for an individual to sustain life at a resting state. Measured in kilocalories, this is the amount of energy the body needs to perform vital functions, such as respiration, maintenance of body temperature, and blood circulation. The resting metabolic rate typically accounts for 60-70% of the total calories expended by the body each day [1]. For the average adult human male (weighing about 154 pounds), the resting metabolic rate is about 2,000 kilocalories per day. [2]

What factors influence the resting metabolic rate?

Several factors influence an individual's resting metabolic rate. Some factors cannot be controlled, but others can be manipulated and monitored to increase the metabolic rate. Each factor is described below.

Genetics

Some individuals have a genetically higher resting metabolic rate. This means they are able to expend more calories at rest compared to an individual with a lower metabolic rate. [3]

Age

As age increases, an individual's resting metabolic rate decreases. It decreases by approximately two percent each decade. This is mainly due to a decrease in lean muscle mass

[3]. Individuals may need as much as 100 fewer kilocalories per day per decade to maintain body weight. [4]

Some studies have shown that Americans lose an average of about one half pound of muscle and add about a pound and a half each year – a net gain of one pound per year – from the mid 20's to the mid 50's. The atrophy of muscle as the human body ages causes the resting metabolic rate to decrease by about five percent each year [5].

Body Composition

Lean muscle tissue requires more energy throughout the day than fat tissue. "Muscle cells are about 8 times more metabolically demanding than fat cells" [3]. Therefore, comparing two individuals of equal body weight, the individual with a greater amount of muscle mass will have a higher resting metabolic rate. One pound of muscle tissue is able to burn calories about eight to nine times the rate of one pound of fat tissue (American Council on Exercise). "An additional three pounds of muscle mass may increase your metabolic rate by about six percent, which translates into burning about 120 more kilocalories per day" [5].

Metabolism is also affected by the surface area-to-mass ratio. Because muscle tissue is denser than adipose tissue it takes up less space, which gives the body a smaller surface area per unit of mass. A smaller body mass does not permit heat storage within the core, and the larger body surface (relative to the body mass) facilitates heat loss, which allows more calories to be expended. This can be expressed in relative terms by determining the number of calories needed for an individual per unit of weight (pounds or kilograms). [2]

Schedule of Eating

The resting metabolic rate increases during the digestion of food, which is a process called the Thermal Effect of food. The increase is due to the extra energy required to absorb

the food, activate the digestive enzymes, and increase blood flow to distribute the nutrients and waste [6]. This process generally accounts for about ten percent of the body's total daily energy expenditure (TDEE). However, it is influenced by genetic factors, is lower in obese individuals, and is influenced by the level of spontaneous activity and the degree of insulin resistance, which all may affect the percentage of daily energy expenditure from this process. The body tends to feel there is a shortage of food if the time period between meals is too long. It reacts to this by slowing its metabolism "holding on" to the calories for fear of starvation [3]. Generally, the time frame for this to take place is after about 5 hours for men and 3 hours for women [3]. To prevent the body's metabolism from hitting the brakes, a snack or meal should be had in these increments in order for the body's metabolism to stay at a relatively constant state.

Nutrition

The process of metabolism is a constant series of chemical reactions that require a constant supply of nutrients. Vitamins such as B2, B3, B5, B6, and vitamin C are examples of essential nutrients. Without these, the metabolic process becomes insufficient. A balanced diet including all food groups is the best recommendation; excluding certain food groups may eliminate essential nutrients from the diet. [1]

Activity level

The metabolic rate increases with physical activity. When the body is active, it requires more energy to sustain the activity. It is important to note here that in the absence of an increase in muscle mass, physical activity will not raise your *resting* metabolic rate. With aerobic exercise, or physical activity added throughout the day, the body's metabolism will fluctuate. Although the baseline (resting metabolic rate) does not increase over time, the

average metabolic rate for the day is higher compared to the average daily metabolic rate of the same individual with little or no physical activity during the day. [11]

The metabolic rate is directly related to the intensity of the physical activity – as intensity increases, the metabolic rate increases. For example, the metabolic rate during moderate exercise (such as walking at a 3.5 – 4.0 mph pace) is five times that of what the same individual expends in a resting state (RMR). Heavy exercise, such as jogging, involves energy expenditure seven times that of what the same individual expends in a resting state. [Form 5]

Increases in hormonal activity contribute to the increase in metabolic rate after endurance exercise. Blood levels of adrenaline and noradrenaline increase most significantly because they are controlled by the sympathetic nerves embedded in the muscles. These hormones stimulate metabolic processes that affect the resting metabolic rate. An increase in protein resynthesis following exercise has also been considered when researching the effect of exercise on resting metabolism. Because proteins are broken down during exercise, synthesis is necessary to keep protein levels constant. Exercise may cause levels of enzymes necessary for protein synthesis to increase. [6]

The resting metabolic rate can be increased through resistance training. Even though the training itself does not increase the rate, it increases as the lean muscle mass increases, as a potential result of the training. As previously described, an individual with a body composition of more lean mass will be able to expend more calories at a resting state compared to an individual of equal weight and less lean mass. "Dr. Catherine Geissler, a nutrition expert at King's College, London estimates that the increased lean body mass associated with exercise can increase total daily energy expenditure by 8% (143

kilocalories/day) for a moderately active person to 14% (286 kilocalories/day) for a highly active person" [6].

Exercise is especially important for individuals in a weight loss phase. "Dieting without exercise results in weight cycling and is detrimental to the resting metabolic rate" [7]. When the body is in a caloric deficit (i.e. on a diet), it uses stored glycogen from the muscles for energy. For every ounce of glycogen depleted from the muscle, three ounces of water is lost [7]. This process is responsible for the initial rapid weight loss experienced near the beginning of the dieting phase. If the caloric intake continues to be restricted, lean muscle mass is degraded in order to make more glucose for energy. Again, as lean muscle mass decreases, resting metabolic rate decreases as well. Adding an exercise component to an individual's weight loss program will help prevent this degradation of the muscle, thus maintaining a higher resting metabolic rate. "A popular theory that supports the importance of exercise for weight loss claims weight is largely controlled by the hypothalamus – the internal regulating center of our brain" [7]. Known as the *set point theory*, body weight throughout adulthood is regulated within a narrow range (± 10%). Dieting alone results in a lowering of the resting metabolic rate by the hypothalamus in order to try and maintain weight (with no affect on the set point). Exercise influences the hypothalamus to lower the set point, readjusting to a lower weight. "The American College of Sports Medicine recommends a daily caloric expenditure of 300-500 kilocalories per day for optimal results during weight loss" [7].

Pregnancy

During pregnancy, a female's resting metabolic rate will increase due to the constant demands of the fetus within the body [2]. Some research has also suggested that there is a

significant variation in the resting metabolic rate of a female throughout the menstrual cycle [8]. Further observations in the variation of the resting metabolic rate during the menstrual cycle may be able to explain the ability of some women to maintain an energy balance more effectively than others.

Hormones and the Autonomic System

Thyroid hormones, growth hormone, and catecholamines from the adrenal medulla increase the metabolic rate, as do the sex hormones, androgen and progesterone. Thyroxin, one of the thyroid hormones, is considered to be a key regulator of the resting metabolic rate. An inadequate level of this hormone can affect an individual's metabolism through changes in body weight, energy level, muscle strength, menstrual cycles, memory, heart rate, and cholesterol levels. An excess of thyroxin, a condition known as thyrotoxicosis, can cause the resting metabolic rate to double. Myxoedema, the condition when too little thyroxin is produced, may cause the resting metabolic rate to decrease by 30 to 40 percent. [1]

The sex hormones seem to play a role in metabolism as well. Testosterone accounts largely for the reason men have a higher resting metabolic rate than women. An increase in progesterone and thyroid hormones are also partially responsible for the increase in metabolic rate during pregnancy. The decrease in resting metabolic rate that occurs with age may be due to lowered sympathetic nervous system activity and catecholamine secretion. [1]

What is the role of RMR during weight loss?

In order to lose weight, an individual must create a caloric deficit, which can be done through a combination of diet and exercise. Over time, the body adapts to the amount of calories it consumes (energy input) and the amount of calories it expends (energy output). In

order to determine how many calories an individual should cut from their diet, it is important to know two things: their activity level and their resting metabolic rate. As stated before, the resting metabolic rate is the number of calories the body needs to survive in a resting state. This is the minimum amount of calories an individual should consume daily for an extended period of time. From this "baseline" the individual's activity level can be accounted for and an estimate of the caloric deficit required to lose weight can be made.

It is important to be aware that as an individual loses weight, their resting metabolic rate decreases. This is due to the fact that there is less body tissue requiring energy to maintain its vital functions. For this reason, it is necessary to recalculate resting metabolic rate frequently throughout the period of weight loss. Participating in a resistance training program to build muscle mass can help counteract this effect to prevent a plateau in weight loss. [5]

How do you estimate an individual's caloric needs?

There are many different formulas that can be used to calculate the caloric maintenance level of an individual. Several of these formulas take into account the factors of age, sex, height, weight, lean body mass, and activity level, which make them more accurate. Any formula that accounts for the individual's lean body mass will give the most accurate estimate of caloric expenditure. Listed below are some different methods for estimating resting metabolic rate (RMR) and total daily energy expenditure (TDEE).

Total Body Weight Method

The quickest method to determine caloric needs is to use the individual's current body weight and use a multiplier determined by their goal. The multiplier's are as follows:

Weight loss: Body weight (lb.) x 12-13 Calories

Maintenance (TDEE): Body Weight (lb.) x 15-16 Calories

Weight Gain: Body Weight (lb.) x 18-19 Calories [10]

Although this method is the most simplistic, it does not take into account activity levels or body composition. Therefore, extremely active individuals may require more calories than this formula indicates. In contrast, the formula greatly overestimates the caloric needs of someone whose body composition contains more fat mass than lean mass.

Harris-Benedict Formula

The Harris Benedict Formula is once again based on total body weight, but it also factors in height, weight, age, and sex to calculate the resting metabolic rate (RMR). The RMR is then used with an activity factor to more accurately estimate the individual's Total Daily Energy Expenditure (TDEE). The only factor this formula does not account for is lean body mass. Therefore it will have acceptable accuracy in all but extremely muscular or extremely overweight individuals. It tends to underestimate the caloric needs of people with large muscle mass and overestimate the needs of those with large fat mass [10]. In an attempt to factor the lean mass, there are separate formulas provided for men and women because men tend to have more lean mass than women. The equations for RMR for men and women are as follows:

Men: RMR = 66 + [13.7 x weight (kg)] + [5 x height (cm)] – [6.8 x age]

Women: RMR = 655 + [9.6 x weight (kg)] + [1.8 x height (cm)] – [4.7 x age]

Once the RMR is determined, it is multiplied by the appropriate activity factor listed below:

Sedentary = RMR x 1.2 (little or no exercise, desk job)

Lightly Active = RMR x 1.375 (light exercise/sports 1-3 days/wk)

Moderately Active = RMR x 1.55 (moderate exercise/sports 3-5 days/wk)

Very Active = RMR x 1.725 (hard exercise/sports 6-7 days/week)

Extremely Active = RMR x 1.9 (hard daily exercise/sports and physical job or training twice daily, i.e. marathon, contest, etc.)

Although these activity factors may not describe every individual's lifestyle accurately, they serve as a good estimate. This formula is probably used the most frequently in the public setting because it tends to be very accurate for the majority population and it does not require any other tests or data other than height and weight. [10]

Katch-McArdle Formula

The most accurate estimate of RMR is the Katch-McArdle formula because it factors in body composition. For this reason, there is a single equation (no reason to separate men and women):

RMR = 370 + [21.6 x lean mass (kg)]

Notice that height and age are not factored in as well. These factors were included in the previous equation to attempt to account for weight distribution and any decrease in lean mass as age increases. Because the lean mass is known in this equation, these factors are not necessary. Muscle tissue is much more metabolically active than fat tissue making it the most important factor to consider when calculating the resting metabolic rate. Therefore, for individuals with a body composition that lies on either side of the "norm" (either very muscular or very obese), the Katch-McArdle Formula proves to be most accurate. Once RMR is determined, the same activity factors listed above can be used to determine an individual's total daily energy expenditure. [10]

Hilton Head Health Institute's Method

The formula used by Hilton Head Health Institute can be viewed on Forms 1-4. Recommended by the Institute of Medicine through the National Academy of Sciences, this formula was found to be the most accurate. The first step to determining the resting metabolic rate is to look at the recommended caloric intake of an individual in relation to their gender, height, and weight (separate charts for women and men). This initial number is based on 30 years of age; therefore it must be adjusted by an age factor (chart found under 1b of Forms 1 and 3). This number is based on five hours of exercise per week. For less active individuals, it can be adjusted by reducing 100 kilocalories per day for every hour less exercise per week.

Once an individual's total daily energy expenditure is calculated, a diet and exercise plan can be developed according to the individual's goals. For weight loss, a caloric deficit should be achieved, meaning the individual's caloric intake should be less than their TDEE. For weight maintenance, caloric intake should remain relatively equal to TDEE. Healthy weight loss is achieved with a goal of 1-2 pounds per week. This requires a deficit of 3,500 to 7,000 kilocalories per week. Because the activity factor is already considered in these equations, the caloric difference required should come from the meal plan, unless the activity level increases over time.

While it may seem that "less is more" when it comes to calories, it is important to note that large caloric deficits can actually revert the body from achieving the goal at hand. "Cutting calories too much slows down the metabolic rate, decreases thyroid output and causes loss of lean muscle mass" [10]. The American College of Sports Medicine recommends that women keep a caloric intake at a minimum of 1200 per day and 1800 per day for men. These levels are still extremely low, but can be safely followed for a short

amount of time (4-6 weeks). Another recommendation that may help for long term weight loss is to reduce calories by 15-20% below TDEE to start. The average total daily energy expenditure for women in the United States is 2,000 – 2,100 kilocalories per day and the average for men is 2,700 – 2,900 kilocalories per day. These numbers range greatly among individuals. For example, some elite athletes require as many as 5,000 – 6,000 kilocalories per day or more just to maintain their weight with their amount of activity [4]. Recalculating the RMR and TDEE for an individual after a weight loss of about 15 pounds will also help in that the TDEE will be more accurate throughout the weight loss phase to prevent plateaus. [10]

Can an individual's Resting Metabolic Rate be measured?

The only accurate and feasible method to measuring resting metabolic rate is called *indirect calorimetry*. It is called "indirect" because it relies on the amount of oxygen taken in to calculate the caloric expenditure rate. "*Direct* calorimetry implies a measurement of heat released by the body which is technically difficult and clinically impractical [10]." Two molecules of oxygen are required to expend one kilocalorie. As a result of the direct relationship between caloric expenditure and oxygen consumption, measuring oxygen uptake is roughly equivalent to measuring caloric expenditure using direct calorimetry. The process requires a very precise measurement of the volume of expired air and of the concentration of oxygen left in the expired air.

DATA ANALYSIS

Introducton

The Hilton Head Health Institute (H^3I) offers their guests the option of purchasing a Metabolic Assessment through the indirect calorimetry method. This provides the guests with a personalized "metabolic fingerprint" which then allows the professionals at the Institute to come up with a more personalized weight loss plan that will provide better long-term benefits. The meal plan the guests are placed on during their stay at the Health Institute is based on 1,200 kilocalories. For many people, this should be considered an aggressive dieting phase of weight loss, and should only be maintained for a maximum of four to six weeks. Guests have the opportunity to consume additional calories throughout the day with optional fruits, salad, and soups. By assessing an individual's resting metabolic rate and their current activity level, an exercise and meal plan can be developed in order to keep the individual in a "weight loss" or "weight management" state depending on their goal.

Before a guest participates in the metabolic assessment, it is important that they refrain from eating or exercising for four hours prior to the test. Food and exercise soon before the assessment will bias the results of the test. The guest also completes an activity form (see Form 5) in which they determine their average activity levels for a twenty-four hour period. They divide the twenty-four hour day into five activity factors: 1) Resting, 2) Very Light, 3) Light, 4) Moderate, and 5) Heavy. They do this by assessing how much time they spend *resting* (sleeping, reading, watching television); doing *very light activity* (sitting and standing activities – driving, playing cards); *light activity* such as walking or light housework; *moderate activity* (brisk walking or gardening); and *heavy activity*, such as running, playing intense sports, etc. This information is then factored into the equation (on Form 5) to

determine the individual's caloric needs based on their goals. The test itself results in a daily caloric expenditure during a resting state. This number is then divided by twenty-four to provide an hourly resting metabolic rate. The hourly rate can be multiplied by each activity factor to more precisely measure how much the individual's caloric intake should be to maintain their current weight. The activity factors used are more accurate than those listed previously with the Harris Benedict equation because these take into account a full twenty-four hour period, breaking up the day rather than averaging out the day's activity. A combination of diet and exercise to create a deficit of 3,500-7,000 kilocalories can then be devised to encourage a one to two-pound weight loss each week (which is the recommended rate of weight loss for success). The attached chart (see Form 6) provides the recommended calorie intake of a person according to their weight and BMI. The guests then receive one of four sheets explaining their metabolic assessment results (Forms 7-10). All four sheets state the individuals measured resting metabolic rate and approximate total daily energy expenditure, along with a suggested caloric intake range for a moderate, healthy rate of weight loss. The first sheet (Form 7) suggests the individual is doing enough physical activity and should maintain this habit. The second sheet (Form 8) suggests the individual is at a current healthy weight and lists suggestions for maintaining it. The third sheet (Form 9) states that, although the individual is currently doing some exercise, it would be beneficial to increase moderate activity by approximately thirty minutes per day. The fourth sheet (Form 10) suggests that the individual increase physical activity by thirty to sixty minutes per day in order to achieve a moderate, healthy rate of weight loss.

The guests are then provided with a mean plan that provides a breakdown of how many servings of each food group are required each day in order to maintain a balanced meal

and provide the energy needed for an active lifestyle. Three different meal plans are offered (Forms 11-13). The first is a 1,200 kilocalorie meal plan including 27 grams of fat. Another plan provides the serving breakdown for 1,600 kilocalories and 44 grams of fat. The third meal plan is a 2,000 kilocalorie plan with 55-66 grams of fat.

Purpose

The purpose of this analysis is to compare the estimated resting metabolic rate with the measured metabolic rate of each individual to determine the usefulness of the test and the possibility of offering it to all the guests as an included portion of the program. Other information can also be concluded from the data, such as average body mass index, average age, and the range of both estimated and measured metabolic rates of both male and females. This information may be beneficial to the Health Institute because it allows for an "average population" to be determined according to age and health status (BMI, RMR). This knowledge of their "average guest" may allow the Health Institute to be better prepared for the majority of their guests. For instance, the educational lectures provided by the Health Institute can be revised to better correlate with the majority of the guests. Examples presented during the classes may also be more personalized or suitable. Fitness options can be adapted to focus on the classes that appeal the most to people of the average age group at the Institute.

Methods

A subject pool of 210 individuals was used in this analysis – 170 women and 40 men. Each individual's resting metabolic rate was estimated using the formula recommended by The Institute of Medicine. The *Body Gym,* an indirect calorimetry system designed by

Healthe Tech was used to measure resting metabolic rate for each subject. Data was collected from the guests through their metabolic assessment and stored in an excel spreadsheet. This is currently an ongoing project; therefore, the pool of data will be constantly increasing for the Institute as the guests participate in the metabolic assessment. For each individual, their gender, date of assessment, height, weight, age, estimated resting metabolic rate and measured resting metabolic rate were recorded. Each individual's body mass index was calculated through Excel spreadsheet using the formula: BMI = weight (kg)/ height (m^2), with the proper conversion factors (1 kg = 2.2 lbs., 1 in. = 0.0254 m). The statistical analysis yielded the following results.

Results

The ratio of women to men was four to one. The average calculated Body Mass Index was 32.317 kg/m^2 for women, 33.914 kg/m^2 for men, and 32.622 kg/m^2 for the entire group. The average age was 49 for women, 50 for men, and 49 for the entire group.

The average estimated RMR for women was 1,548.560 kilocalories (kcal) and 2,031.925 kcal for men, with the average estimated RMR for the entire group at 1,640.630 kcal. The average measured RMR for women was 1,433.765 kcal, 1,870.250 kcal for men, and 1,516.905 kcal for the entire group. The average difference in estimated and measured RMR values for each subject was 114.795 kcal for women, 161.675 kcal for men, and 123.725 kcal for the entire group. The maximal difference between the estimated and measured RMR values for each subject was 575 kcal for women and 871 kcal for men. See the section labeled GRAPHS for comparisons between Estimated RMR and Age (for Women and Men); Measured RMR and Age (Women and Men); BMI and Age; Estimated and

Measured RMR values (Women and Men); BMI and Measured RMR (Women and Men); and Weight and Measured RMR (Women and Men).

Conclusions

It is evident from the Body Mass Index (BMI) that the average guest at H^3I is obese (BMI greater than 30.0 kg/m^2). Individuals with a BMI between 25 and 29.9 kg/m^2 are considered overweight. Since nearly two-thirds (67.5%) of U.S. adults are classified as overweight and almost one-third (30.6%) are obese, weight loss centers like H^3I are in great demand. With an average guest's age of 49, it can be concluded that the "baby boomers", as they are referred to, are currently the largest group to market to. As these baby boomers age, they are becoming more aware of their health needs and are searching out facilities such as H^3I to obtain the education and resources needed to live healthier lives.

At H^3I, the 1,200 kilocalorie meal plan is designed to create a caloric deficit to facilitate weight loss in combination with exercise. When looking at the average RMR values (both measured and estimated) for the guests at H^3I, the average measured RMR for women was 1,433 kcal. Without the exercise component, this would only allow a deficit of about 1630 kcal/week. As previously stated, a deficit of 3500 kcal is needed to result in a loss of one pound. Therefore, for some individuals, this meal plan is not as aggressive as it may be for individuals with higher RMR values. This fact only accentuates the need for the exercise component to be combined with diet for significant weight loss.

While the average difference between the estimated and measured RMR for individuals was less than 200 kcal, it is important to note that the maximal difference was 575 kcal for women and 871 kcal for men. Two hundred calories may not seem significant when

you are comparing a daily intake of 1,600 kcal to 1,800 kcal. However, the difference between being able to consume 2,000 kilocalories and still lose weight compared to consuming only 1,200 kilocalories would be significant. From this information, it is important to understand that, while on average the difference between the measured and estimated values for RMR may not be large; for any individual, the difference may even be as much as almost 900 kcal. Short of continual trial and error, there is no way to conclude that an individual's measured RMR will be relatively similar to their estimated RMR. Therefore, the indirect calorimetry method used for determining RMR is a useful tool for H^3I's guests as they develop their weight loss/management plan.

Graph 1 shows the relationship between estimated RMR and age for women. The R^2 value, one measure of the goodness of fit, is 0.0622. Through this value we can see that age is **not** a strong factor in determining an individual's estimated RMR *for this population.* Remember this is a biased population in that the average individual is obese (BMI > 30 kg/m^2). Graph 2, showing the relationship between measured RMR and age for women, has an R^2 of 0.037 – showing even less relation between the two factors. Graphs 3 and 4 showed similar results for the men.

Graph 5 demonstrates that, for the average population at H^3I there is not much correlation between age and BMI. R^2 is 0.0008. Again, this does not mean that there is no relationship between BMI and age, however, for the average guest, BMI is similar across all age groups, regardless of gender. The measure of goodness of fit for the relationship between Estimated RMR and Measured RMR for both women (0.6178) and men (0.6421), were higher than that of these values related to age. On average, there is a trend, but again, due to the test having such high individual benefits, these R^2 values are not high enough to be considered

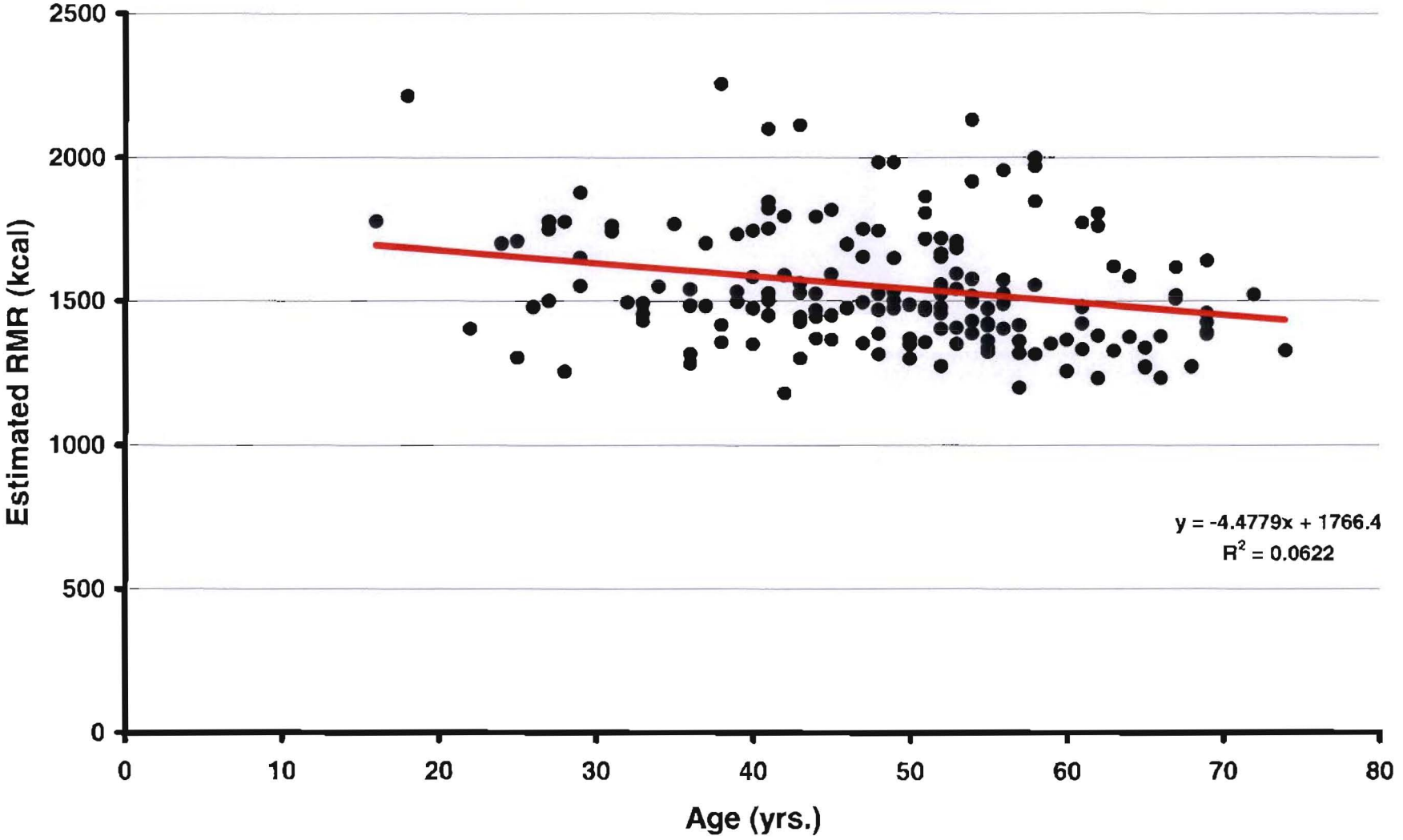
significant (> 0.75). The estimated value is not accurate enough to continually pinpoint an individual's RMR value. Graphs 8 and 9 demonstrate the relationship between BMI and Measured RMR for women and men. Again, although the R^2 values (0.4133 and 0.4257), are relatively high it is not sufficiently high enough to recommend using one factor to predict the other. Graphs 10 and 11, showing weight versus measured RMR show similar results with R^2 values of 0.5543 and 0.5592, respectively. These numbers show that body weight may have a larger impact on RMR in comparison to BMI, which also factors height into the comparison.

Again, it is important to remember that these conclusions were derived from data involving generally overweight/obese individuals rather than a holistic population. This data suggests that, for the given population, weight may have a larger affect on RMR than age.

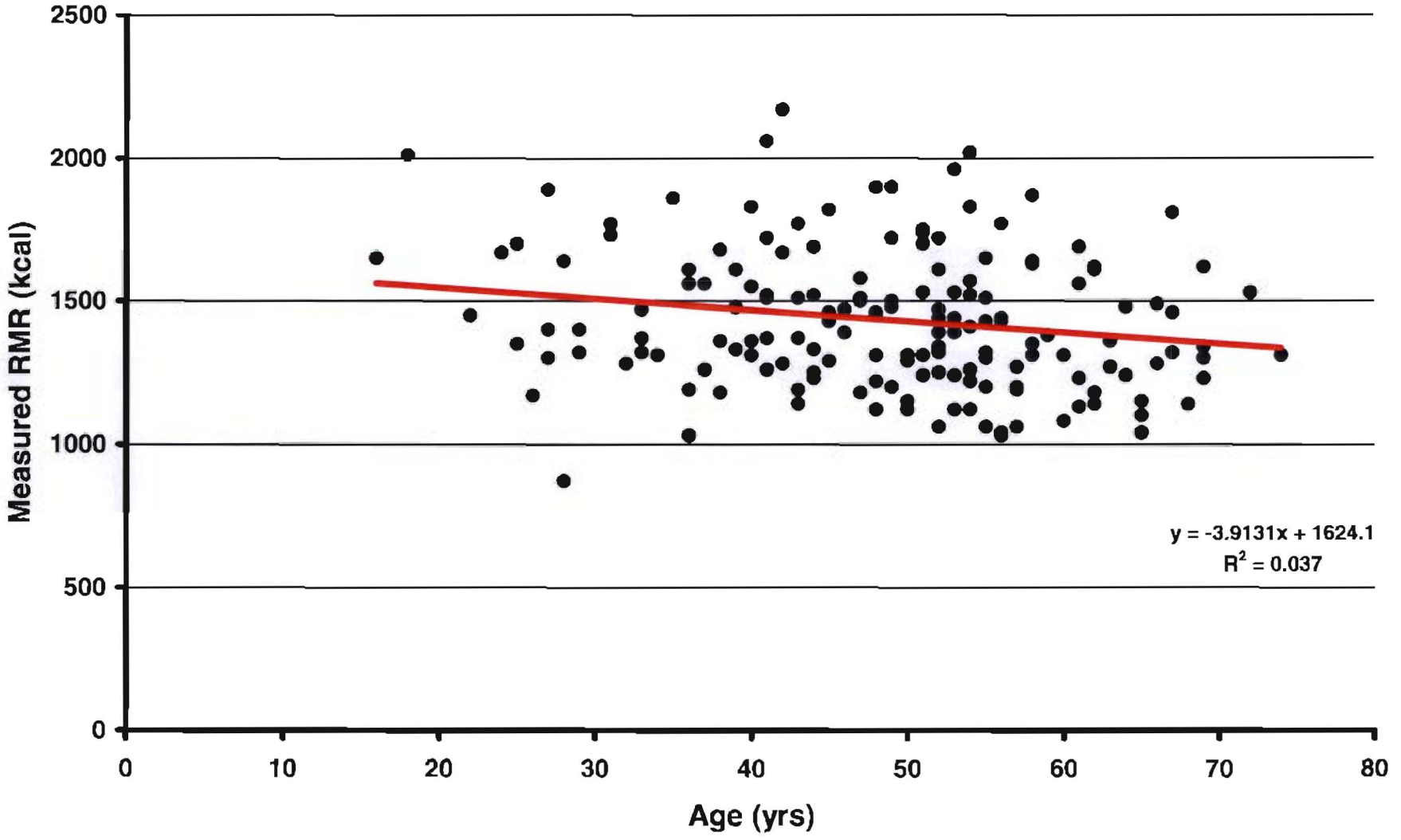
Based on the results of this study, the indirect calorimetry method remains a beneficial tool offered to the guests at the Hilton Head Health Institute. Currently, the test provides an additional source of profit because it is provided as an additional service ("a la carte"). Due to the accuracy (on average) of the estimating formula used, providing only the *estimated* RMR for all guests and providing metabolic assessments only to those interested may be the most appropriate approach. The test remains available to all guests, and is included as part of the Next Level Fitness specialty program.

List of Graphs

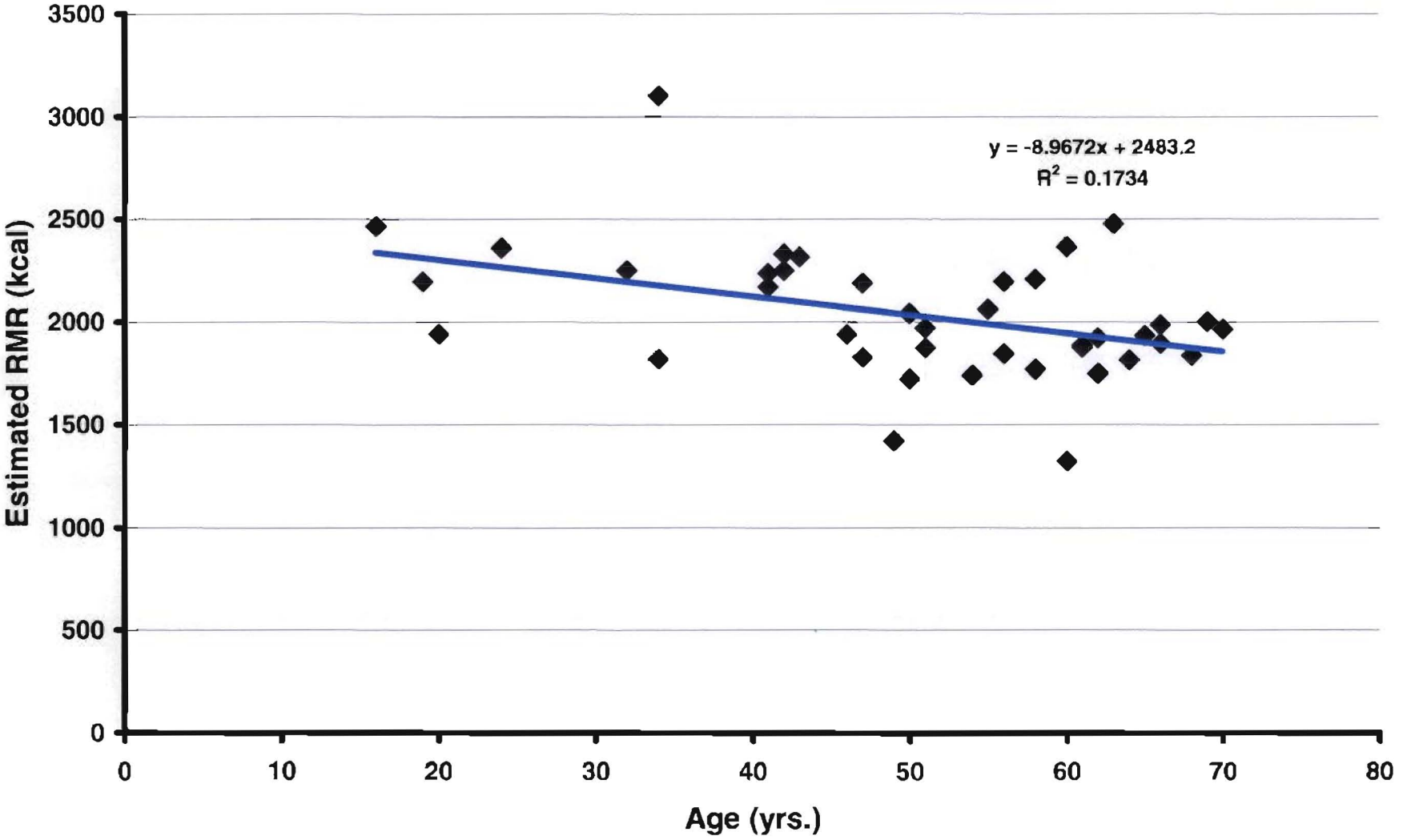
Graph 1. Estimated RMR vs. Age - *Women*



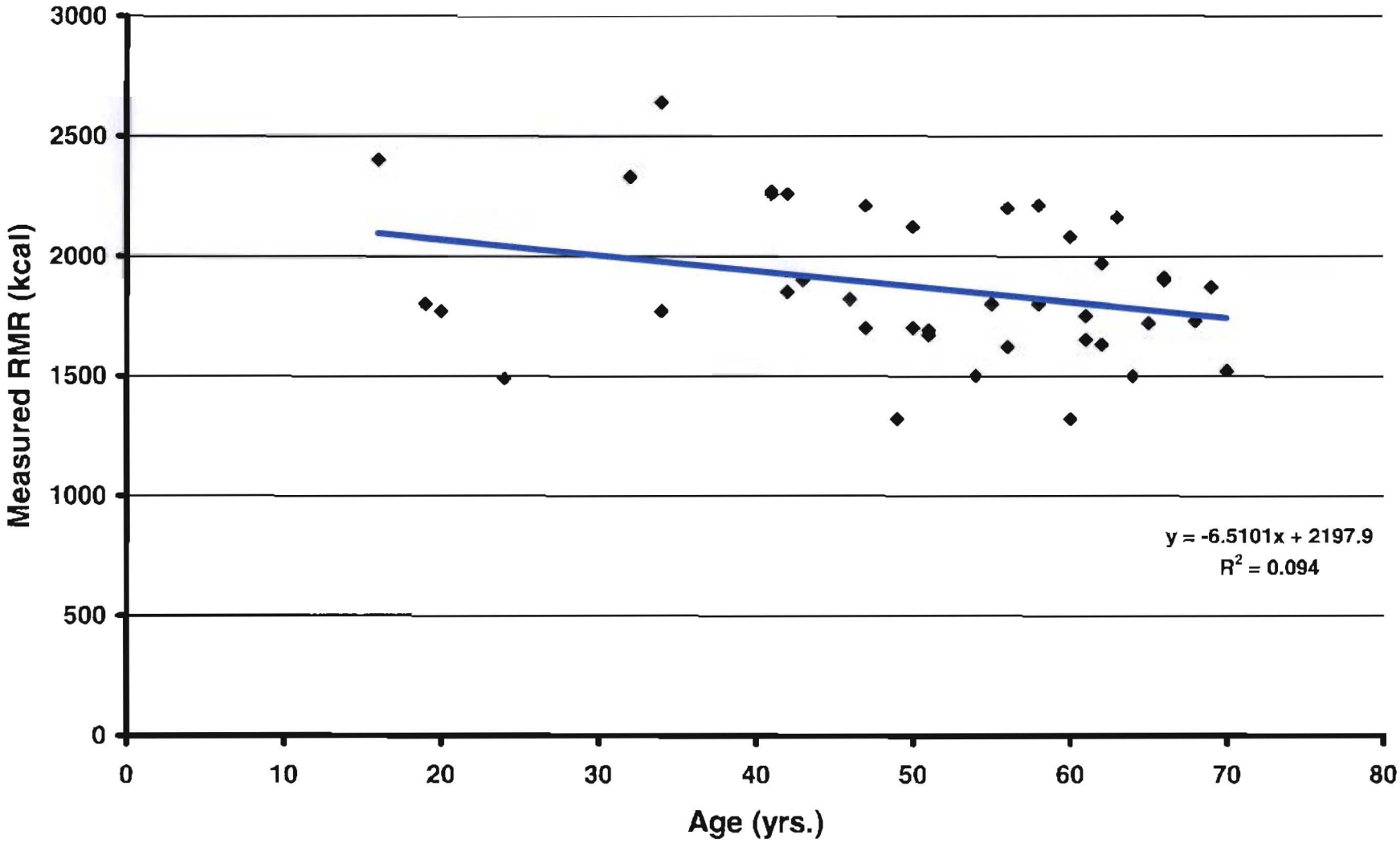
Graph 2. Measured RMR Values vs. Age - *Women*



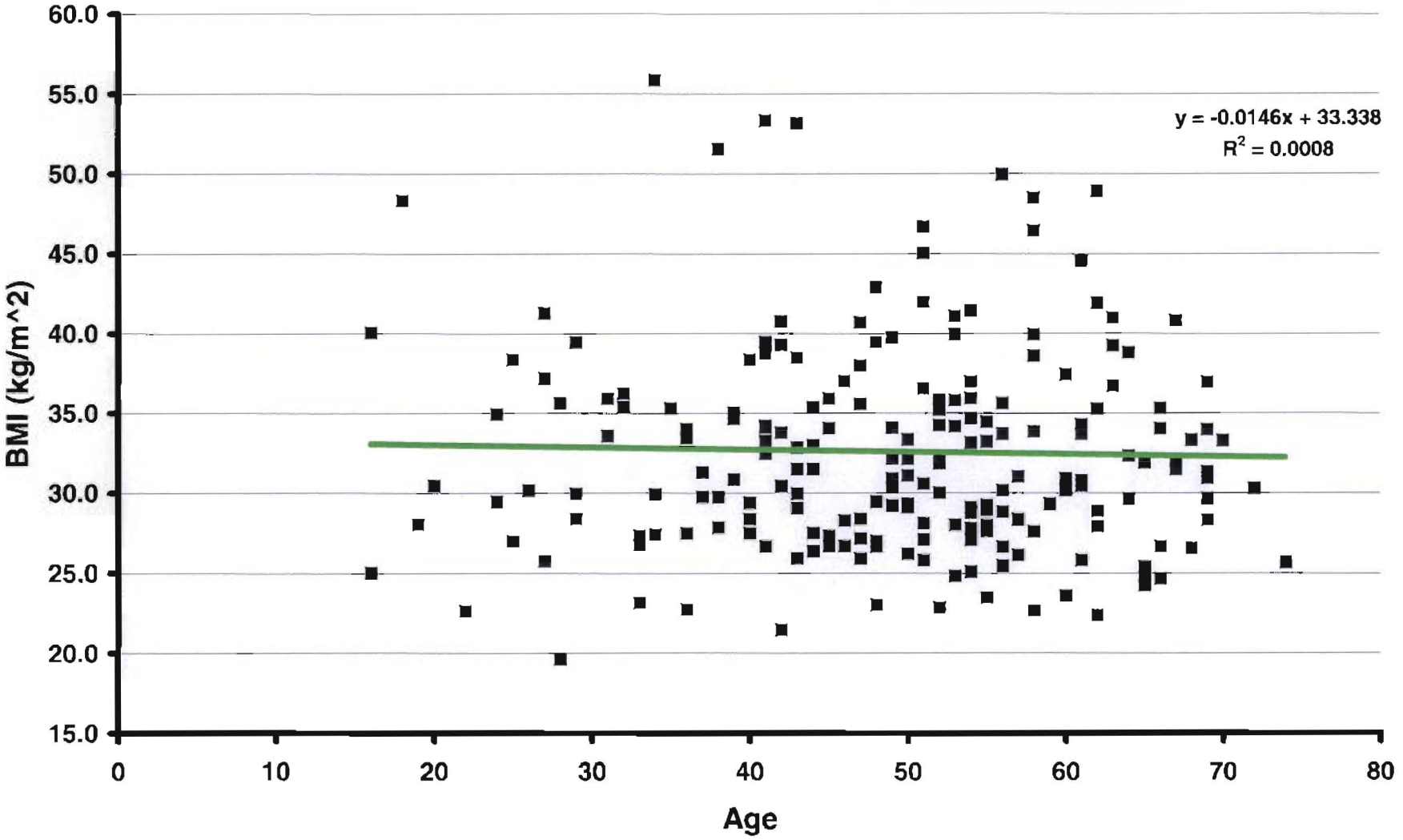
Graph 3. Estimated RMR vs. Age - *Men*



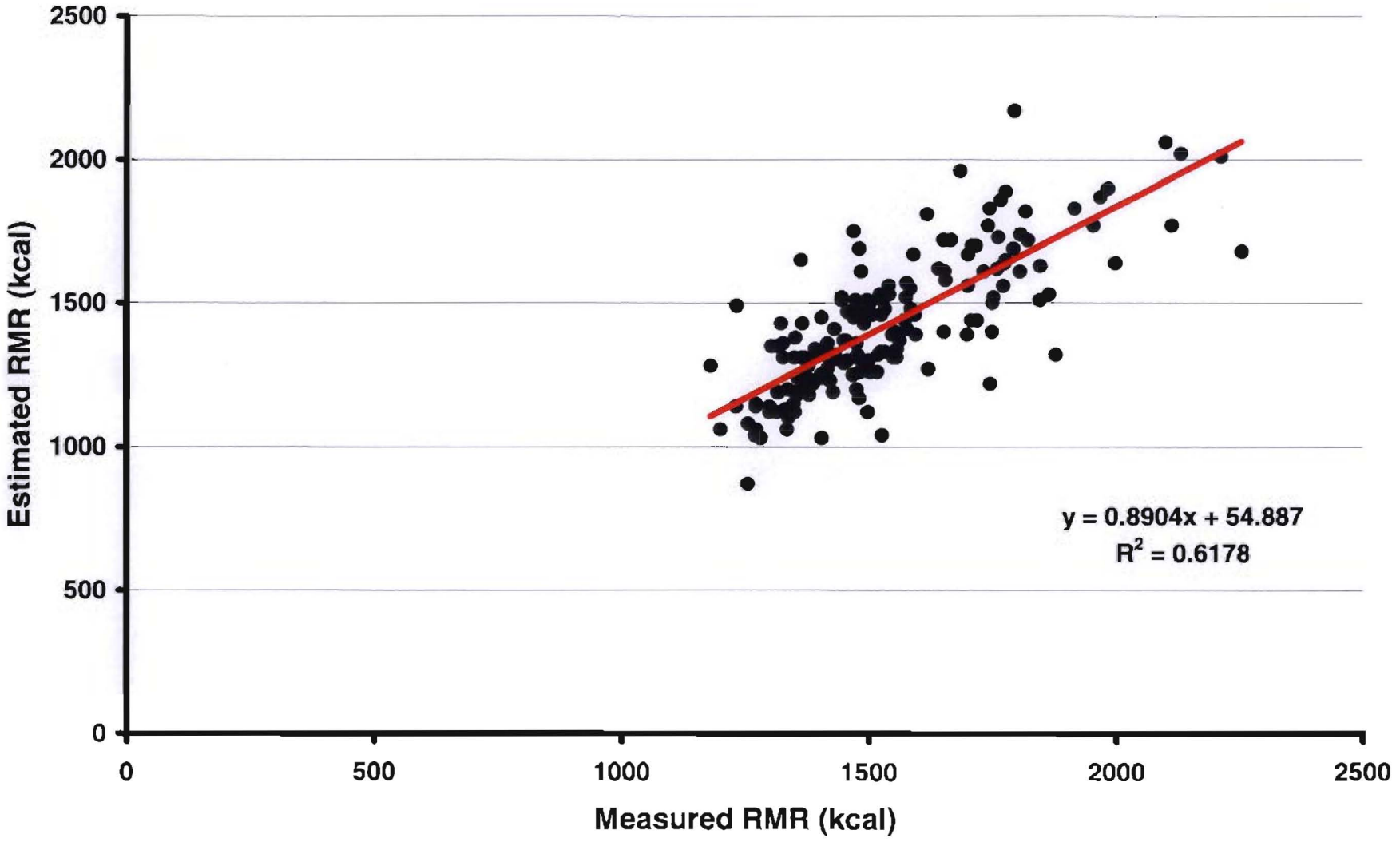
Graph 4. Measured RMR vs. Age - *Men*



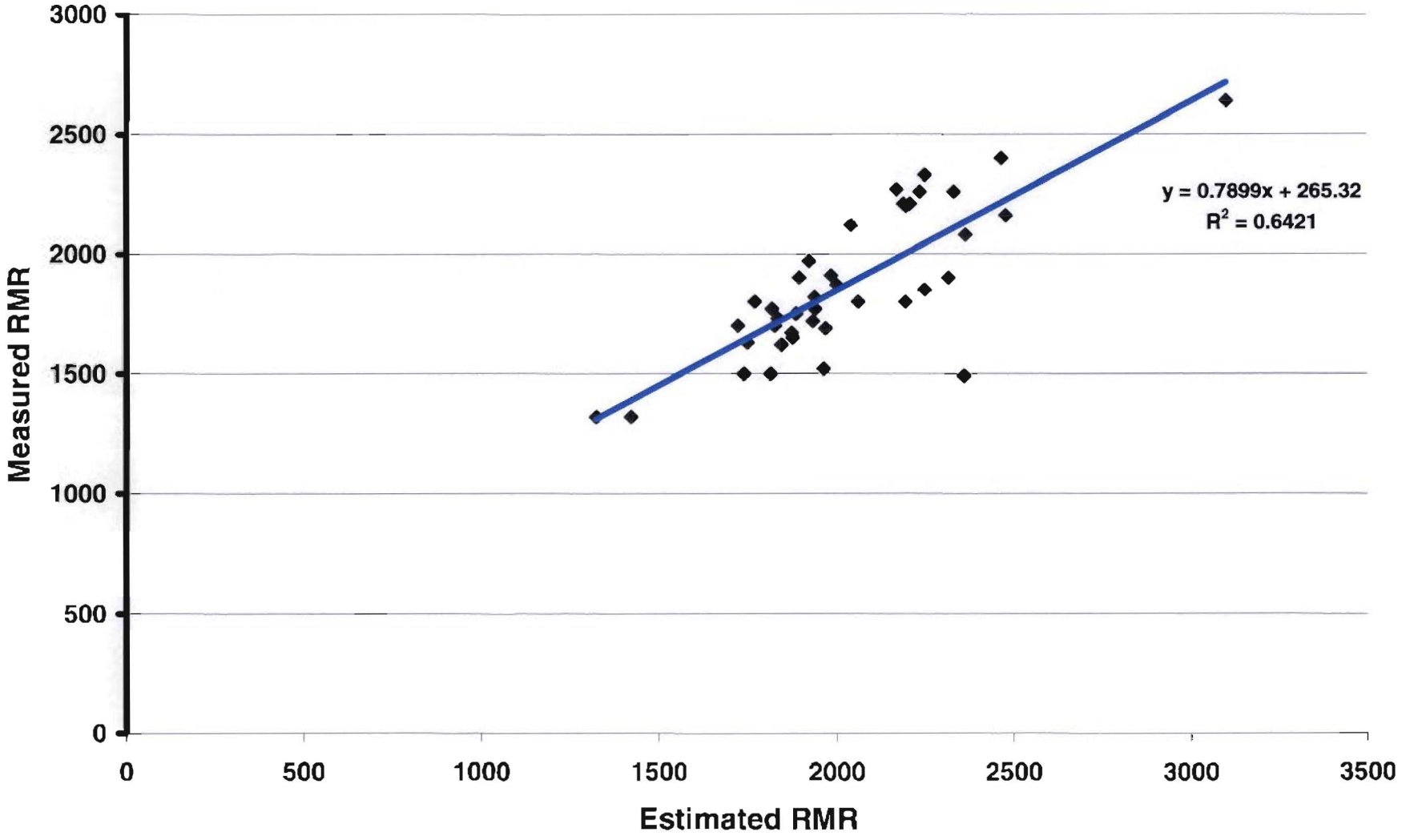
Graph 5. BMI vs. Age - *Both Genders*



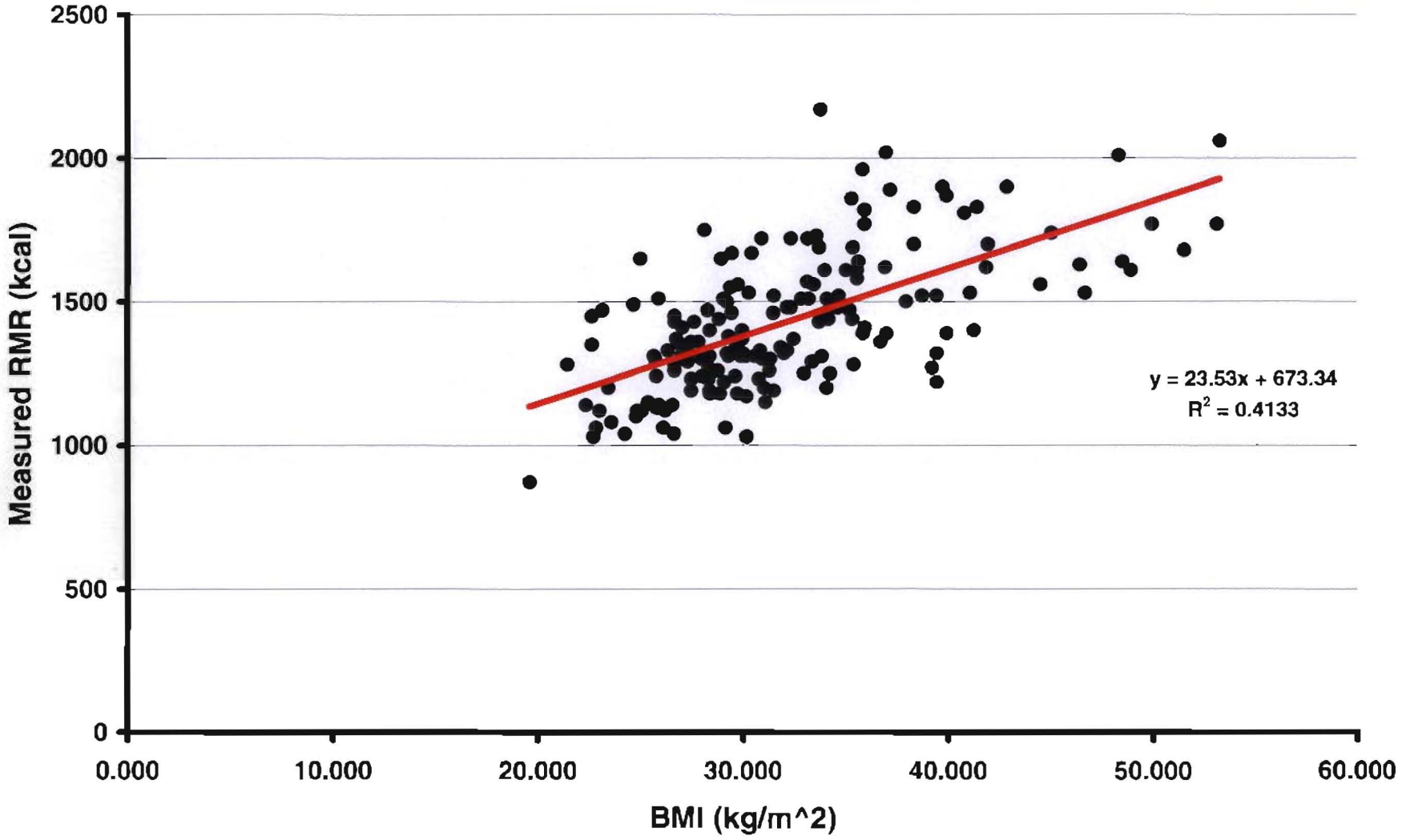
Graph 6. Estimated RMR vs. Measured RMR - *Women*



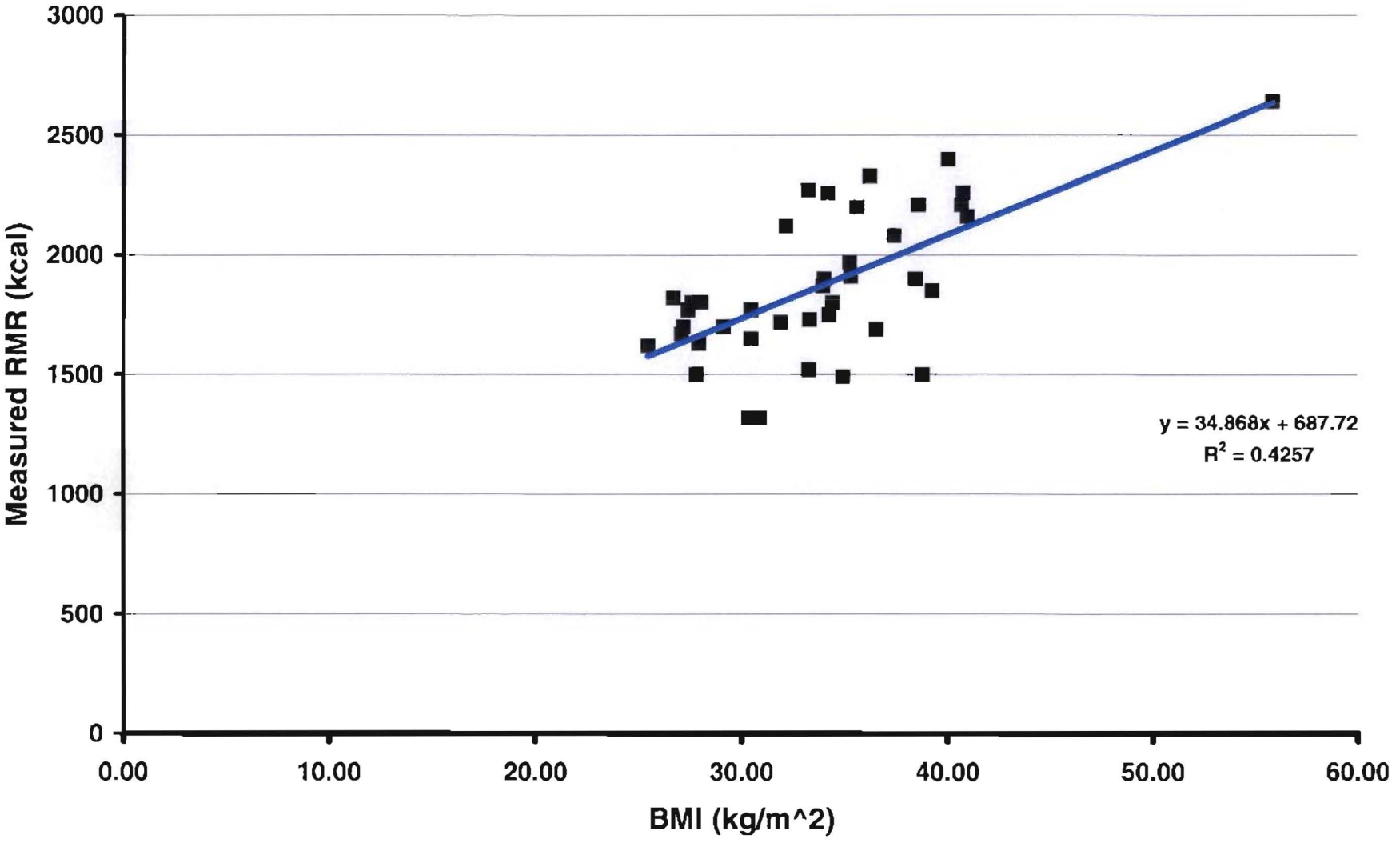
Graph 7. Estimated RMR vs. Measured RMR - *Men*



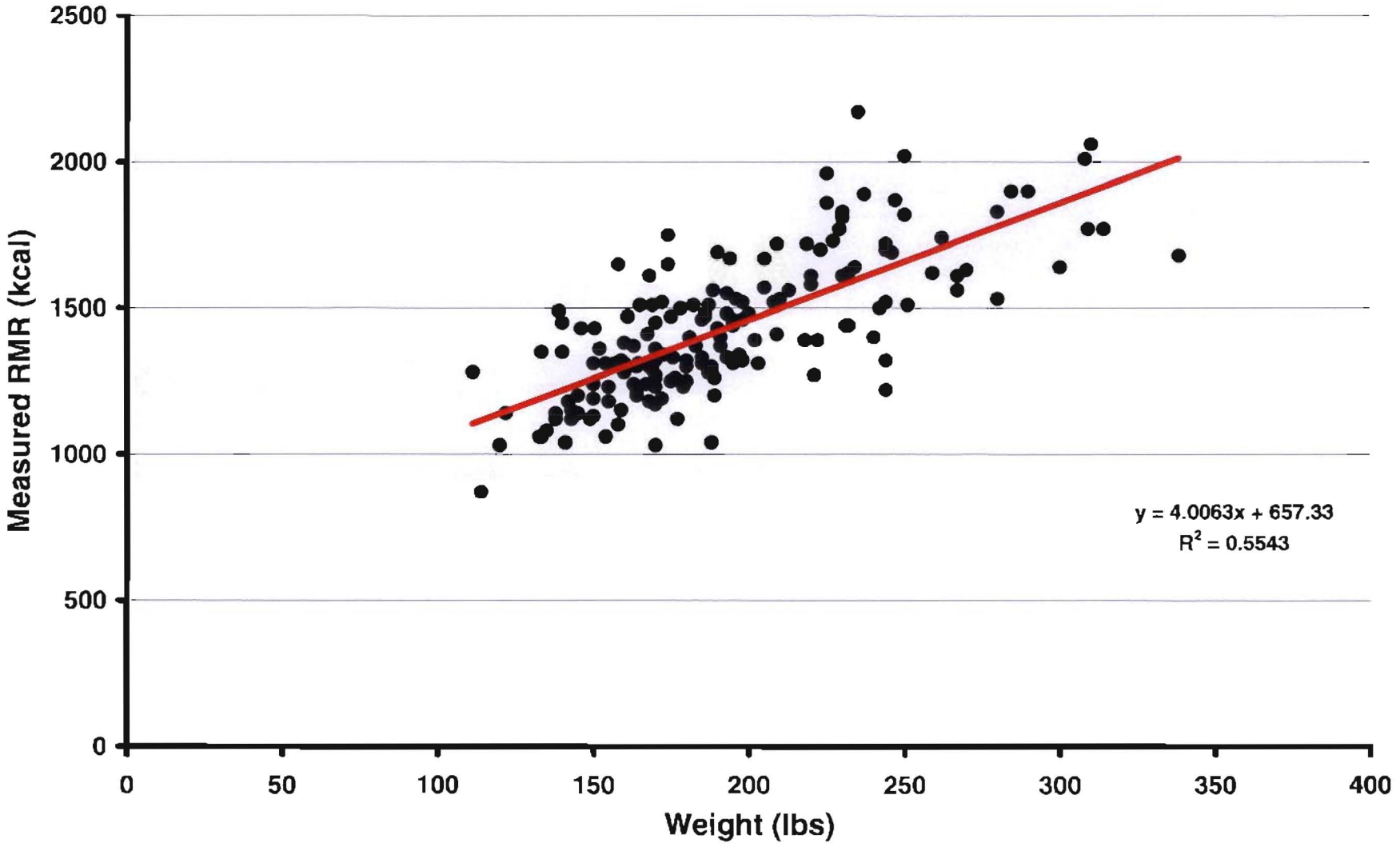
Graph 8. BMI vs. Measured RMR - *Women*



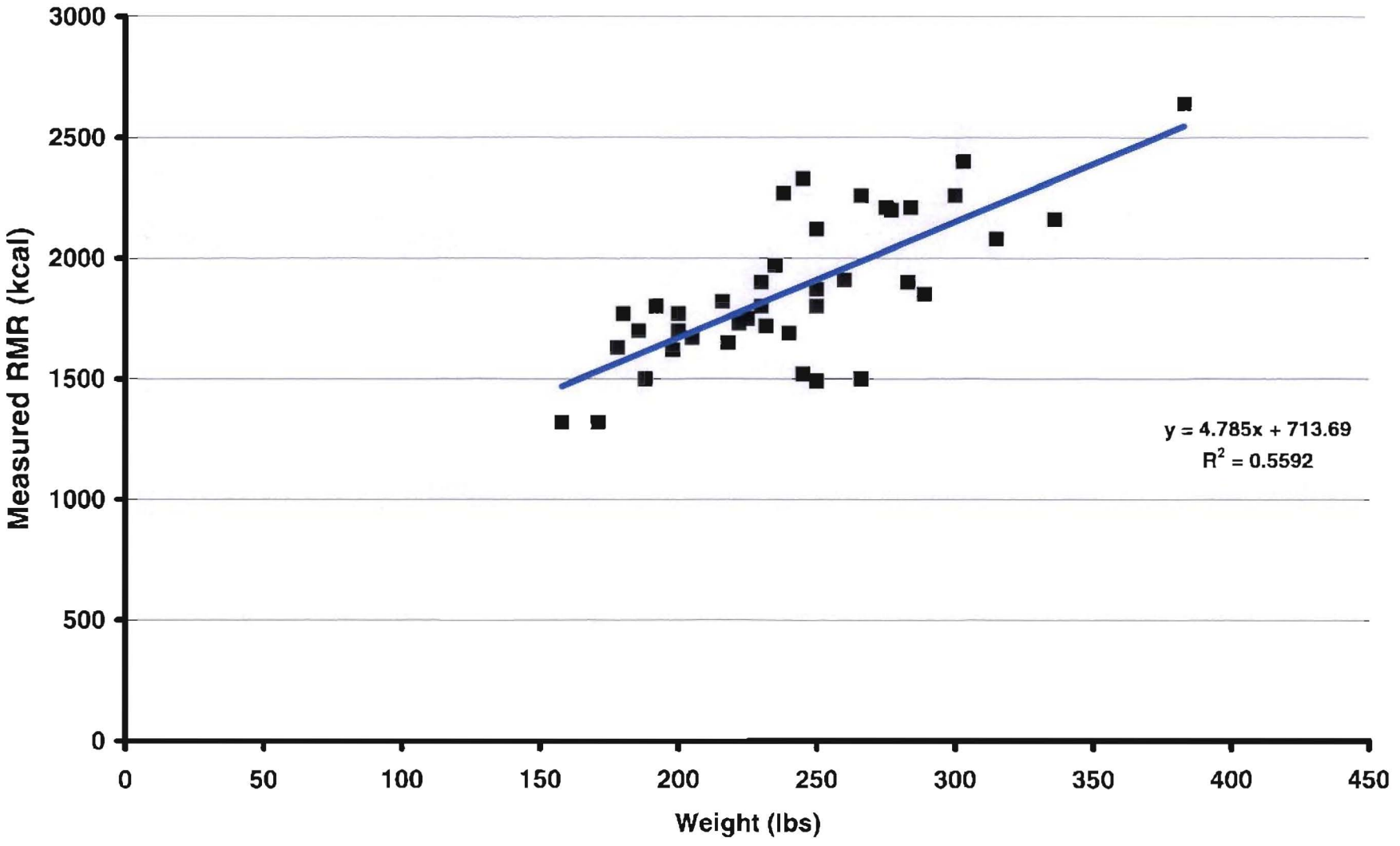
Graph 9. BMI vs. Measured RMR - *Men*



Graph 10. Weight vs. Measured RMR - *Women*



Graph 11. Weight vs. Measured RMR - *Men*



List of Hilton Head Health Institute Handouts / Forms

Form 1 – H^3I Planning for Home – Women

Form 2 – Estimated Resting Metabolic Rate (RMR) in Women (Chart)

Form 3 – H^3I Planning for Home – Men

Form 4 – Estimated Resting Metabolic Rate (RMR) in Men (Chart)

Form 5 – H^3I Total Daily Caloric Energy Expenditure Worksheet

Form 6 – Current Weight, BMI, and Caloric Intake Recommendation Chart (for 10% weight loss)

Form 7 – Metabolic Assessment Results, handout 1

Form 8 – Metabolic Assessment Results, handout 2

Form 9 – Metabolic Assessment Results, handout 3

Form 10 – Metabolic Assessment Results, handout 4

Form 11 – 1,200 kilocalorie Meal Plan

Form 12 – 1,600 kilocalorie Meal Plan

Form 13 – 2,000 kilocalorie Meal Plan

H³I
Planning for Home - *Women*

Form 1

I. Determining Your Weight Loss Caloric Range

A. Aggressive stage (Low end of your weight loss caloric range)
- No less than 1200 calories/day

1. Determine the upper end of your weight loss caloric range

a. Refer to the RMR and chart and locate the RMR for your height and current weight

- *Note: If your weight is not on the chart, use the weight listed that is nearest to yours.*

RMR = _____ (Based on 30 years of age)

b. Using the chart below, adjust RMR for your age

Age	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
+/- RMR	30	28	25	23	20	18	15	13	10	8	5	3	0	-3	-5	-8	-10	-13	-15	-18	-20
Age	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
+/- RMR	-23	-25	-28	-30	-33	-35	-38	-40	-43	-45	-48	-50	-53	-55	-58	-60	-63	-65	-68	-70	-73
Age	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
+/- RMR	-75	-78	-80	-83	-85	-88	-90	-93	-95	-98	-100	-103	-105	-108	-110	-113	-115	-118	-120	-123	-125

Your Adjusted RMR

RMR — [ ]

+/– Age Adjustment — +/– [ ]

= Adjusted RMR — = [ ]

c. Adjusted RMR = Your Upper End

d. Weight loss Caloric Range = 1200 to _____

II. Determining Estimated Maintenance Caloric Level

Maintenance Calories = upper end calories + physical activity

Based on 5 hours of exercise a week, physical activity calorie expenditure = 50% upper end

Maintenance = upper end + 50% of your upper end

Example: Upper Range = 1800
50% of upper end = 900

Example

1800
+ 900
2700

[ ]
+ [ ]

Maintenace Caloric Level = [ ]

Note: For every hour less per week you exercise, reduce your maintenance by 100 calories per day.

Form 2

Estimated Resting Metabolic Rate (RMR) in Women

	Weight																					
Height(in)	**82**	**87**	**93**	**99**	**105**	**110**	**116**	**121**	**125**	**130**	**134**	**139**	**144**	**148**	**153**	**157**	**162**	**167**	**171**	**176**	**180**	**185**
57	1074	1089	1104	1128	1152	1177	1201	1219	1237	1255	1273	1291	1309	1327	1346	1364	1382	1400	1418	1436	1454	1472
	85	**91**	**96**	**102**	**108**	**114**	**120**	**125**	**130**	**134**	**139**	**144**	**149**	**154**	**158**	**163**	**168**	**173**	**177**	**182**	**187**	**192**
58	1096	1111	1127	1152	1177	1202	1227	1246	1264	1283	1301	1320	1339	1358	1376	1395	1414	1433	1451	1470	1489	1508
	88	**94**	**100**	**106**	**112**	**118**	**124**	**129**	**134**	**139**	**144**	**149**	**154**	**159**	**164**	**169**	**174**	**179**	**184**	**188**	**193**	**198**
59	1118	1134	1150	1175	1201	1227	1253	1272	1291	1311	1330	1349	1368	1388	1407	1427	1446	1465	1485	1504	1524	1543
	91	**97**	**103**	**109**	**115**	**122**	**128**	**133**	**138**	**144**	**149**	**154**	**159**	**164**	**169**	**174**	**180**	**185**	**190**	**195**	**200**	**205**
60	1141	1157	1173	1200	1226	1253	1280	1299	1319	1339	1359	1379	1399	1419	1439	1459	1479	1499	1519	1539	1559	1579
	95	**100**	**106**	**113**	**119**	**126**	**132**	**137**	**143**	**148**	**154**	**159**	**164**	**169**	**175**	**180**	**185**	**190**	**196**	**201**	**207**	**212**
61	1163	1180	1197	1224	1251	1279	1306	1327	1347	1368	1388	1409	1430	1450	1471	1491	1512	1533	1553	1574	1594	1615
	98	**104**	**109**	**116**	**123**	**130**	**137**	**142**	**148**	**153**	**159**	**164**	**169**	**175**	**180**	**186**	**191**	**197**	**202**	**208**	**213**	**219**
62	1186	1203	1220	1248	1277	1305	1333	1354	1376	1397	1418	1440	1461	1482	1503	1525	1546	1567	1589	1610	1631	1653
	101	**107**	**113**	**120**	**127**	**134**	**141**	**147**	**152**	**158**	**163**	**169**	**175**	**180**	**186**	**191**	**197**	**203**	**209**	**214**	**220**	**226**
63	1208	1226	1244	1273	1302	1331	1360	1382	1404	1426	1448	1470	1492	1514	1536	1558	1580	1602	1624	1646	1668	1690
	105	**111**	**116**	**124**	**131**	**138**	**146**	**151**	**157**	**163**	**169**	**175**	**180**	**186**	**192**	**198**	**204**	**209**	**215**	**221**	**227**	**233**
64	1231	1250	1268	1298	1328	1358	1388	1410	1433	1456	1478	1501	1524	1546	1569	1592	1615	1637	1660	1683	1705	1728
	109	**114**	**120**	**128**	**135**	**143**	**150**	**156**	**162**	**168**	**174**	**180**	**186**	**192**	**198**	**204**	**210**	**216**	**222**	**228**	**234**	**240**
65	1254	1273	1293	1323	1354	1384	1415	1438	1462	1485	1509	1532	1555	1579	1602	1626	1649	1672	1696	1719	1743	1766
	112	**118**	**124**	**131**	**139**	**147**	**155**	**161**	**167**	**173**	**179**	**186**	**192**	**198**	**204**	**210**	**217**	**223**	**229**	**235**	**241**	**248**
66	1278	1297	1317	1349	1380	1412	1443	1467	1491	1515	1539	1564	1588	1612	1636	1660	1684	1708	1732	1756	1780	1805
	116	**122**	**128**	**135**	**143**	**151**	**159**	**165**	**172**	**178**	**185**	**191**	**197**	**204**	**210**	**217**	**223**	**229**	**236**	**242**	**249**	**255**
67	1301	1322	1342	1374	1407	1439	1471	1496	1521	1545	1570	1595	1620	1645	1669	1694	1719	1744	1769	1793	1818	1843
	120	**126**	**131**	**139**	**148**	**156**	**164**	**171**	**177**	**184**	**190**	**197**	**203**	**210**	**216**	**223**	**230**	**236**	**243**	**249**	**256**	**263**
68	1326	1347	1368	1401	1434	1467	1500	1525	1551	1576	1602	1627	1653	1678	1704	1729	1755	1781	1806	1832	1857	1883
	124	**129**	**135**	**144**	**152**	**161**	**169**	**176**	**182**	**189**	**195**	**202**	**209**	**216**	**222**	**229**	**236**	**243**	**250**	**256**	**263**	**270**
69	1350	1372	1393	1427	1461	1494	1528	1554	1580	1607	1633	1659	1685	1712	1738	1765	1791	1817	1844	1870	1897	1923

Hilton Head Health INSTITUTE

Estimated Resting Metabolic Rate (RMR) in Women

	128	**133**	**139**	**148**	**156**	**165**	**174**	**180**	**187**	**194**	**201**	**208**	**215**	**222**	**229**	**236**	**243**	**250**	**257**	**264**	**271**	**278**
70	1374	1396	1419	1453	1488	1522	1557	1584	1611	1638	1665	1692	1719	1746	1774	1801	1828	1855	1882	1909	1936	1964
	132	**137**	**143**	**152**	**161**	**169**	**178**	**185**	**192**	**200**	**207**	**214**	**221**	**228**	**236**	**243**	**250**	**257**	**264**	**271**	**278**	**285**
71	1398	1421	1444	1480	1515	1551	1586	1614	1642	1669	1697	1725	1753	1781	1809	1837	1865	1893	1921	1948	1976	2004
	135	**141**	**147**	**156**	**165**	**174**	**184**	**191**	**198**	**205**	**213**	**220**	**227**	**235**	**242**	**250**	**257**	**264**	**272**	**279**	**286**	**294**
72	1423	1447	1470	1507	1543	1579	1616	1644	1673	1701	1730	1759	1787	1816	1845	1874	1903	1931	1960	1988	2017	2046
	139	**145**	**151**	**160**	**170**	**179**	**189**	**196**	**204**	**211**	**219**	**226**	**234**	**241**	**249**	**256**	**264**	**272**	**279**	**287**	**294**	**302**
73	1448	1472	1497	1534	1571	1608	1645	1674	1704	1733	1763	1792	1822	1851	1881	1910	1940	1969	1999	2028	2058	2087
	143	**149**	**155**	**165**	**174**	**184**	**194**	**202**	**209**	**217**	**225**	**233**	**240**	**248**	**256**	**263**	**271**	**279**	**287**	**294**	**302**	**310**
74	1474	1498	1523	1561	1599	1637	1676	1706	1736	1766	1796	1827	1857	1887	1917	1948	1978	2008	2038	2069	2099	2129
Source: National Acedemy of Science																						

H³I
Planning for Home - *Men*

Form 3

I. Determining Your Weight Loss Caloric Range

A. Aggressive stage (Low end of your weight loss caloric range)
- No less than 1200 calories/day

1. Determine the upper end of your weight loss caloric range

a. Refer to the RMR and chart and locate the RMR for your height and current weight

- *Note: If your weight is not on the chart, use the weight listed that is nearest to yours.*

RMR = _____ (Based on 30 years of age)

b. Using the chart below, adjust RMR for your age

Age	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
+/- RMR	48	44	40	36	32	28	24	20	16	12	8	4	0	-4	-8	-12	-16	-20	-24	-28	-32
Age	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
+/- RMR	-36	-40	-44	-48	-52	-56	-60	-64	-68	-72	-76	-80	-84	-88	-92	-96	-100	-104	-108	-112	-116
Age	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
+/- RMR	-120	-124	-128	-132	-136	-140	-144	-148	-152	-156	-160	-164	-168	-172	-176	-180	-184	-188	-192	-196	-200

		Your Adjusted RMR
	RMR	
+/–	Age Adjustment	+/–
=	Adjusted RMR	=

c. Adjusted RMR = Your Upper End

d. Weight loss Caloric Range = 1200 to _____

II. Determining Estimated Maintenance Caloric Level

Maintenance Calories = upper end calories + physical activity

Based on 5 hours of exercise a week, physical activity calorie expenditure = 50% upper end

Maintenance = upper end + 50% of your upper end

Example: Upper Range = 1800
50% of upper end = 900

Example

1800
+ 900
2700

	+	
Maintenace Caloric Level	=	

Note: For every hour less per week you exercise, reduce your maintenance by 100 calories per day.

Form 4

Hilton Head Health INSTITUTE

Estimated Resting Metabolic Rate(RMR) in Men

	Weight																				
eight (in)	88	94	100	106	112	118	124	129	134	139	144	149	154	159	164	169	174	179	184	188	193	198
59	1246	1277	1308	1340	1377	1408	1433	1456	1479	1501	1524	1547	1570	1592	1615	1637	1660	1683	1706	1728	1751	1774
	91	97	103	109	115	122	128	133	138	144	149	154	159	164	169	174	180	185	190	195	200	205
60	1274	1306	1337	1369	1400	1432	1464	1487	1511	1534	1558	1582	1605	1628	1652	1675	1699	1722	1746	1769	1793	1817
	95	100	106	113	119	126	132	137	143	148	154	159	164	169	175	180	185	190	196	201	207	212
61	1302	1334	1366	1398	1430	1462	1494	1518	1543	1567	1592	1616	1640	1664	1689	1713	1737	1761	1786	1810	1835	1859
	98	104	109	116	123	130	137	142	148	153	159	164	169	175	180	186	191	197	202	208	213	219
62	1344	1374	1404	1435	1465	1495	1526	1551	1576	1601	1626	1651	1676	1701	1726	1751	1777	1802	1827	1852	1877	1902
	101	107	113	120	127	134	141	147	152	158	163	169	175	180	186	191	197	203	209	214	220	226
63	1385	1414	1442	1471	1500	1528	1557	1583	1609	1634	1660	1686	1712	1738	1764	1790	1816	1842	1868	1893	1919	1945
	105	111	116	124	131	138	146	151	157	163	169	175	180	186	192	198	204	209	215	221	227	233
64	1401	1432	1463	1495	1526	1558	1589	1616	1642	1669	1695	1722	1749	1776	1802	1829	1856	1883	1909	1936	1963	1990
	109	114	120	128	135	143	150	156	162	168	174	180	186	192	198	204	210	216	222	228	234	240
65	1416	1450	1484	1519	1553	1587	1621	1648	1676	1703	1731	1758	1786	1813	1841	1868	1896	1924	1951	1979	2006	2034
	112	118	124	131	139	147	155	161	167	173	179	186	192	198	204	210	217	223	229	235	241	248
66	1446	1480	1515	1550	1584	1619	1654	1682	1710	1738	1767	1795	1823	1852	1880	1909	1937	1966	1994	2023	2051	2080
	116	122	128	135	143	151	159	165	172	178	185	191	197	204	210	217	223	229	236	242	249	255
67	1475	1510	1545	1581	1616	1651	1686	1715	1744	1774	1803	1832	1861	1890	1920	1949	1978	2007	2037	2066	2096	2125
	120	126	131	139	148	156	164	171	177	184	190	197	203	210	216	223	230	236	243	249	256	263
68	1505	1541	1576	1612	1648	1683	1719	1749	1779	1809	1839	1870	1900	1930	1960	1990	2020	2050	2080	2111	2141	2171
	124	129	135	144	152	161	169	176	182	189	195	202	209	216	222	229	236	243	250	256	263	270
69	1535	1571	1607	1644	1680	1716	1752	1783	1814	1845	1876	1907	1938	1969	2000	2031	2062	2093	2124	2155	2186	2217
	128	133	139	148	156	165	174	180	187	194	201	208	215	222	229	236	243	250	257	264	271	278
70	1566	1602	1639	1676	1713	1749	1786	1818	1850	1882	1914	1946	1977	2009	2041	2073	2105	2137	2169	2201	2233	2265
	132	137	143	152	161	169	178	185	192	200	207	214	221	228	236	243	250	257	264	271	278	285
71	1596	1633	1671	1708	1745	1783	1820	1853	1886	1918	1951	1984	2017	2050	2082	2115	2148	2181	2214	2246	2279	2312

Estimated Resting Metabolic Rate(RMR) in Men

	135	**141**	**147**	**156**	**165**	**174**	**184**	**191**	**198**	**205**	**213**	**220**	**227**	**235**	**242**	**250**	**257**	**264**	**272**	**279**	**286**	**294**
72	1627	1665	1703	1741	1779	1817	1855	1888	1922	1956	1989	2023	2057	2090	2124	2158	2192	2225	2259	2293	2327	2361
	139	**145**	**151**	**160**	**170**	**179**	**189**	**196**	**204**	**211**	**219**	**226**	**234**	**241**	**249**	**256**	**264**	**272**	**279**	**287**	**294**	**302**
73	1658	1697	1735	1774	1812	1851	1889	1924	1958	1993	2027	2062	2097	2131	2166	2200	2235	2270	2305	2339	2374	2409
	143	**149**	**155**	**165**	**174**	**184**	**194**	**202**	**209**	**217**	**225**	**233**	**240**	**248**	**256**	**263**	**271**	**279**	**287**	**294**	**302**	**310**
74	1690	1729	1768	1807	1846	1885	1924	1960	1995	2031	2066	2102	2138	2173	2209	2244	2280	2282	2284	2286	2441	2290
	148	**153**	**159**	**169**	**179**	**189**	**199**	**207**	**215**	**223**	**231**	**239**	**247**	**255**	**262**	**270**	**278**	**286**	**294**	**302**	**310**	**318**
75	1721	1761	1800	1840	1880	1919	1959	1996	2032	2069	2105	2142	2179	2215	2252	2288	2325	2294	2263	2233	2507	2171
	152	**158**	**163**	**173**	**184**	**194**	**204**	**212**	**220**	**229**	**237**	**245**	**253**	**261**	**269**	**277**	**286**	**294**	**302**	**310**	**318**	**327**
76	1753	1793	1834	1874	1914	1955	1995	2033	2070	2108	2145	2183	2220	2258	2295	2333	2371	2339	2308	2277	2558	2215
	156	**162**	**168**	**178**	**188**	**199**	**209**	**217**	**226**	**234**	**243**	**251**	**259**	**268**	**276**	**285**	**293**	**301**	**310**	**318**	**327**	**335**
77	1785	1826	1867	1908	1949	1990	2031	2069	2108	2146	2185	2223	2262	2300	2339	2377	2416	2384	2353	2321	2608	2258

Source: National Academy of Science

H^3I
TOTAL DAILY CALORIC EXPENDITURE WORKSHEET

Name:		Date:	Time:
Height:	Weight:	Age:	Est. RMR:

Resting Metabolic Rate = _____

Resting Metabolic Rate = per hour _____

Estimated Total Caloric Expenditure

Activity Level	Hrs/Day		Activity Factor				Cal/Hr		Total Calories
Resting	_____	X	1	=	_____	X	_____	=	_____
Very Light	_____	X	1.5	=	_____	X	_____	=	_____
Light	_____	X	2.5	=	_____	X	_____	=	_____
Moderate	_____	X	5	=	_____	X	_____	=	_____
Heavy	_____	X	7	=	_____	X	_____	=	_____

Estimated Total Caloric Expenditure = _____

ACTIVITY FACTOR	Multiple of RMR
1. **Resting:** Sleeping, reading, watching TV	1.0
2. **Very Light:** Sitting and standing activities, such as driving, playing cards, typing	1.5
3. **Light:** Activities comparable to walking at a normal pace, light housework, sports such as golf, bowling, archery; active jobs such as electrical, carpentry, waiting tables, nursing	2.5
4. **Moderate:** Walking 3.5 - 4.0 mph (brisk pace), active gardening (weeding, hoeing), sports such as cycling, tennis, dancing	5.0
5. **Heavy:** Jogging, vigorous sports such as basketball, soccer	7.0

Form 6

Current Weight, 10% Loss, and Calories Chart

lbs.	kg.	10% loss	BMI 25-29	BMI 30+	lbs.	kg.	10% loss	BMI 25-29	BMI 30+	lbs.	kg.	10% loss	BMI 25-29	BMI 30+
124	56	112	1296	1127	**182**	83	164	1903	1655	**242**	110	218	2530	2200
126	57	113	1317	1145	**184**	84	166	1924	1673	**244**	111	220	2551	2218
128	58	115	1338	1164	**186**	85	167	1945	1691	**246**	112	221	2572	2236
130	59	117	1359	1182	**188**	85	169	1965	1709	**248**	113	223	2593	2255
132	60	119	1380	1200	**190**	86	171	1986	1727	**250**	114	225	2614	2273
134	61	121	1401	1218	**192**	87	173	2007	1745	**252**	115	227	2635	2291
136	62	122	1422	1236	**194**	88	175	2028	1764	**254**	115	229	2655	2309
138	63	124	1443	1255	**196**	89	176	2049	1782	**256**	116	230	2676	2327
140	64	126	1464	1273	**198**	90	178	2070	1800	**258**	117	232	2697	2345
142	65	128	1485	1291	**200**	91	180	2091	1818	**260**	118	234	2718	2364
144	65	130	1505	1309	**202**	92	182	2112	1836	**262**	119	236	2739	2382
146	66	131	1526	1327	**204**	93	184	2133	1855	**264**	120	238	2760	2400
148	67	133	1547	1345	**206**	94	185	2154	1873	**266**	121	239	2781	2418
149	68	134	1558	1355	**208**	95	187	2175	1891	**268**	122	241	2802	2436
150	68	135	1568	1364	**210**	95	189	2195	1909	**270**	123	243	2823	2455
152	69	137	1589	1382	**212**	96	191	2216	1927	**272**	124	245	2844	2473
154	70	139	1610	1400	**214**	97	193	2237	1945	**274**	125	247	2865	2491
156	71	140	1631	1418	**216**	98	194	2258	1964	**276**	125	248	2885	2509
158	72	142	1652	1436	**218**	99	196	2279	1982	**278**	126	250	2906	2527
160	73	144	1673	1455	**220**	100	198	2300	2000	**280**	127	252	2927	2545
162	74	146	1694	1473	**222**	101	200	2321	2018	**282**	128	254	2948	2564
164	75	148	1715	1491	**224**	102	202	2342	2036	**284**	129	256	2969	2582
166	75	149	1735	1509	**226**	103	203	2363	2055	**286**	130	257	2990	2600
168	76	151	1756	1527	**228**	104	205	2384	2073	**288**	131	259	3011	2618
170	77	153	1777	1545	**230**	105	207	2405	2091	**290**	132	261	3032	2636
172	78	155	1798	1564	**232**	105	209	2425	2109	**292**	133	263	3053	2655
174	79	157	1819	1582	**234**	106	211	2446	2127	**294**	134	265	3074	2673
176	80	158	1840	1600	**236**	107	212	2467	2145	**296**	135	266	3095	2691
178	81	160	1861	1618	**238**	108	214	2488	2164	**298**	135	268	3115	2709
180	82	162	1882	1636	**240**	109	216	2509	2182	**300**	136	270	3136	2727

METABOLIC ASSESSMENT RESULTS FOR:

_____

Your resting metabolic rate is _____ calories. Based on the information you provided about your current physical activity level, your total caloric expenditure is approximately _____ per day. If you were to maintain your current level of physical activity, a caloric intake of _____ - _____ calories per day should result in moderate, healthy rate of weight loss. Since weight loss is unpredictable, it is important to have other ways to monitor your progress in addition to the scale. Also, keep in mind, the best ways to enhance your resting metabolic rate are to consume 5-6 well-balanced meals a day, maintain a moderate level of aerobic exercise (30-60 minutes a day most days of the week), and most importantly – maintain a program of resistance training.

Form 8

Hilton Head Health
INSTITUTE

METABOLIC ASSESSMENT RESULTS FOR:

_____

Your resting metabolic rate is _____ calories. Based on the information you provided about your current physical activity level, your total caloric expenditure is approximately _____ per day. If you were to maintain your current level of physical activity, a caloric intake of approximately _____ calories per day should result in maintaining your current healthy weight. Keep in mind, the best ways to enhance your resting metabolic rate are to consume 5-6 well-balanced meals a day; maintain a moderate level of aerobic exercise (30-60 minutes a day, most days of the week), and most importantly – maintain a program of resistance training.

14 VALENCIA ROAD HILTON HEAD ISLAND, SC 29928
843.785.3919 800.292.2440 FAX 843.686.5659 www.hhhealth.com

Hilton Head Health
INSTITUTE

METABOLIC ASSESSMENT RESULTS FOR:

_____

Your resting metabolic rate is _____ calories. Based on the information you provided about your current physical activity level, your total caloric expenditure is approximately _____ per day. If you were to maintain your current level of physical activity, a caloric intake of _____ calories per day should result in moderate, healthy rate of weight loss. The addition of another 30 minutes of moderate activity per day will increase your calorie expenditure, enhancing your weight loss and increase probability of maintaining your weight loss. Since weight loss is unpredictable, it is important to have other ways to monitor your progress in addition to the scale. Also keep in mind, the best ways to enhance your resting metabolic rate is to consume 5-6 well-balanced meals a day, maintain a moderate level of aerobic exercise (30-60 minutes a day, most days of the week), and most importantly – maintain a program of resistance training.

14 VALENCIA ROAD HILTON HEAD ISLAND, SC 29928
843.785.3919 800.292.2440 FAX 843.686.5659 www.hhhealth.com

METABOLIC ASSESSMENT RESULTS FOR:

_____

Your resting metabolic rate is _____ calories. Based on the information you provided about your current physical activity level, your total caloric expenditure is approximately _____ per day. The addition of another 30-60 minutes of moderate activity per day will increase your calorie expenditure, resulting in a moderate, healthy rate of weight loss with a daily caloric intake of _____ calories. Since weight loss is unpredictable, it is important to have other ways to monitor your progress in addition to the scale. Also keep in mind, the best ways to enhance your resting metabolic rate is to consume 5-6 well-balanced meals a day, maintain a moderate level of aerobic exercise (30-60 minutes a day, most days of the week), and most importantly – maintain a program of resistance training.

Hilton Head Health
INSTITUTE

Calories and Meal Plans

Plan A *~1200 calories, 27g fat*

	Breakfast	Lunch	Dinner	Metabomeals™	Daily Total
Nuts & Seeds					0
Monounsaturated Fats					0
Lean Protein (fish x 2)		2 oz.	4 oz.		6 oz. (incl. at least two 3 oz. servings of fish each week)
Low Fat Dairy	1	1			2
Whole Grains/ Legumes	1	1	1		3
Fruits and Vegetables	1	1	1	2	5

This meal plan has been designed to assist you in reaching the next victory goal. Your *Daily Total* is the number of servings recommended from each food group. If you are choosing lower calorie and lower fat options (*better* and *best* choices) from each food group, the *daily total* of servings will correspond to the recommended calories. Please see the H^3I Nutrition Pyramid™ for specific serving sizes.

The break down of *meals* is an example to show how one can divide one's servings throughout the day to maintain energy and avoid hunger. You can devise a *meal* breakdown that works best for your schedule.

Remember, H^3I advises three meals and at least two Metabomeals™ daily.

** The calories listed are meant to be examples of how one can divide their recommended calories throughout the day. Calories of food items vary greatly. We suggest that you devise a plan that works best for your schedule.*

Hilton Head Health
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Calories and Meal Plans

Plan B *~1600 calories, 44g fat*

	Breakfast	Lunch	Dinner	Metabomeals™	Daily Total
Nuts and Seeds					2 ounces per week
Monounsaturated Fats		1	1		2
Lean Protein (fish x2)		2 oz.	4 oz.		6 oz. (incl. at least two 3 oz. servings of fish each week)
Low Fat Dairy	1	1			2
Whole Grains/ Legumes	1	2	1		4
Fruits and Vegetables	1	1	1	2	5

This meal plan has been designed to assist you in reaching the next victory goal. Your *Daily Total* is the number of servings recommended from each food group. If you are choosing lower calorie and lower fat options (*better* and *best* choices) from each food group, the *daily total* of servings will correspond to the recommended calories. Please see the H^{3}I Nutrition Pyramid™ for specific serving sizes.

The break down of *meals* is an example to show how one can divide one's servings throughout the day to maintain energy and avoid hunger. You can devise a *meal* breakdown that works best for your schedule.

Remember, H^{3}I advises three meals and at least two Metabomeals™ daily.

** The calories listed are meant to be examples of how one can divide their recommended calories throughout the day. Calories of food items vary greatly. We suggest that you devise a plan that works best for your schedule.*

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Calories and Meal Plans

Plan C *~2000 calories, 55-66g fat*

	Breakfast	Lunch	Dinner	Metabomeals™	Daily Total
Nuts and Seeds					3 ounces per week
Monounsaturated Fats		1	2		3
Lean Protein (fish x2)		2 oz.	4 oz.		6 oz. (incl. at least two 3 oz. servings of fish each week)
Low Fat Dairy	1	1			2
Whole Grains/ Legumes	1	2	1	1	5
Fruits and Vegetables	1	1	2	2	6

This meal plan has been designed to assist you in reaching the next victory goal. Your *Daily Total* is the number of servings recommended from each food group. If you are choosing lower calorie and lower fat options (*better* and *best* choices) from each food group, the *daily total* of servings will correspond to the recommended calories. Please see the H³I Nutrition Pyramid™ for specific serving sizes.

The break down of *meals* is an example to show how one can divide one's servings throughout the day to maintain energy and avoid hunger. You can devise a *meal* breakdown that works best for your schedule.

Remember, H³I advises three meals and at least two Metabomeals™ daily.

** The calories listed are meant to be examples of how one can divide their recommended calories throughout the day. Calories of food items vary greatly. We suggest that you devise a plan that works best for your schedule.*

Subject	Gender	Date	Measured RMR	Estimated RMR	Height	Weight	Age	BMI	Difference: Est. - Meas. RMR
Subject 1	F	6/4/04	1470	1457	61	186	52	35.218	-13
Subject 2	F	6/11/04	1410	1577	64	209	54	35.950	167
Subject 3	F	6/11/04	1460	1525	66.5	185	48	29.474	65
Subject 4	F	6/15/04	1350	1304	59	133.4	25	27.000	-46
Subject 5	F	6/21/04	2020	2131	69	250	54	36.996	111
Subject 6	F	6/21/04	1030	1282	61	120	36	22.721	252
Subject 7	F	6/25/04	1440	1718	68	232	52	35.349	278
Subject 8	F	6/25/04	1320	1878	66	244	29	39.465	558
Subject 9	F	6/30/04	1770	2112	64.5	314	43	53.177	342
Subject 10	F	6/30/04	1100	1338	67	158	65	24.798	238
Subject 11	F	7/1/04	1860	1767	67	225	35	35.314	-93
Subject 12	F	7/1/04	1630	1847	64	270	58	46.442	217
Subject 13	F	7/2/04	1550	1584	68	193	40	29.407	34
Subject 14	F	7/7/04	1430	1366	63	150.4	45	26.698	-64
Subject 15	F	7/8/04	1280	1378	65	160	66	26.681	98
Subject 16	F	7/8/04	1200	1475	62.5	189	49	34.089	275
Subject 17	F	7/9/04	1470	1492	70	161	33	23.149	22
Subject 18	F	7/14/04	1700	1716	64	244	51	41.970	16
Subject 19	F	7/16/04	1680	2255	68	338.4	38	51.561	575
Subject 20	F	7/16/04	1430	1323	61	146	55	27.644	-107
Subject 21	F	7/20/05	1080	1256	63.5	135	60	23.588	176
Subject 22	F	7/20/04	1240	1357	64	150	51	25.801	117
Subject 23	F	7/21/04	1190	1428	62	172	43	31.525	238
Subject 24	F	7/21/04	1170	1480	63	170	26	30.177	310
Subject 25	F	7/30/04	1320	1477	65	180	52	30.016	157
Subject 26	F	8/4/04	2010	2213	67	308	18	48.340	203
Subject 27	F	8/4/04	2060	2100	64	310	41	53.323	40
Subject 28	F	8/5/04	1190	1319	61	150	57	28.402	129
Subject 29	F	8/5/04	1040	1526	70.5	188	56	26.650	486
Subject 30	F	8/10/04	1400	1651	67	191	29	29.977	251
Subject 31	F	8/10/04	1650	1777	70	174	16	25.019	127
Subject 32	F	8/10/04	1180	1356	58	142	38	29.740	176
Subject 33	F	8/10/04	1360	1417	62	152	38	27.859	57
Subject 34	F	8/11/04	1460	1507	66	194.8	67	31.507	47
Subject 35	F	8/12/04	1330	1525	68.5	175.6	44	26.367	195

Subject 36	F	8/13/04	1260	1482	63	176.4	37	31.313	222
Subject 37	F	8/18/04	1290	1450	66	169	45	27.334	160
Subject 38	F	8/18/04	1300	1500	67	164	27	25.740	200
Subject 39	F	8/18/04	1890	1777	67	237	27	37.197	-113
Subject 40	F	8/19/04	1670	1700	70	205	24	29.476	30
Subject 41	F	8/19/04	1690	1793	70	246	44	35.371	103
Subject 42	F	8/24/04	1380	1352	62	160	59	29.326	-28
Subject 43	F	8/24/04	1810	1617	63	230	67	40.828	-193
Subject 44	F	8/24/04	1740	1807	64	262	51	45.066	67
Subject 45	F	8/25/04	1830	1916	69	280	54	41.435	86
Subject 46	F	8/26/04	1560	1540	63	188.6	36	33.479	-20
Subject 47	F	8/26/04	1470	1475	66	175	46	28.305	5
Subject 48	F	8/26/04	1140	1300	61.25	138	43	25.917	160
Subject 49	F	8/26/04	1320	1415	64	170	55	29.241	95
Subject 50	F	8/27/04	1120	1315	65	138	48	23.012	195
Subject 51	F	9/8/04	1690	1480	63	190	61	33.727	-210
Subject 52	F	9/5/04	1460	1593	64	198	45	34.058	133
Subject 53	F	9/5/04	1650	1363	62	158	55	28.959	-287
Subject 54	F	9/5/04	1390	1698	65	222	46	37.020	308
Subject 55	F	9/7/04	1750	1469	66	174	51	28.143	-281
Subject 56	F	9/7/04	1490	1233	63	139	66	24.674	-257
Subject 57	F	9/21/04	1450	1405	66	140	22	22.644	-45
Subject 58	F	9/21/04	1200	1337	66	145	55	23.453	137
Subject 59	F	9/22/04	1610	1732	68	230	39	35.045	122
Subject 60	F	9/22/04	1360	1475	66	170	40	27.496	115
Subject 61	F	9/22/04	1180	1354	62	155	47	28.409	174
Subject 62	F	9/21/04	1300	1422	65	168	55	28.015	122
Subject 63	F	9/23/04	1530	1541	60	210	53	41.099	11
Subject 64	F	9/23/04	1480	1532	65	193	49	32.184	52
Subject 65	F	9/24/04	1510	1445	64	169	43	29.069	-65
Subject 66	F	9/24/04	1040	1270	64	141	65	24.253	230
Subject 67	F	9/28/04	1030	1405	63	170	56	30.177	375
Subject 68	F	9/28/04	1320	1432	64	159	33	27.349	112
Subject 69	F	9/29/04	1870	1968	66	247	58	39.950	98
Subject 70	F	10/1/04	1440	1707	69	231	53	34.184	267
Subject 71	F	10/13/04	1290	1488	63	188	50	33.372	198
Subject 72	F	10/20/04	1220	1745	66	244	48	39.465	525

Subject 73	F	10/15/04	1120	1497	70.5	177	54	25.090	377
Subject 74	F	10/21/04	1390	1595	62	218	53	39.956	205
Subject 75	F	10/21/04	1510	1496	67	165	47	25.897	-14
Subject 76	F	10/27/05	1060	1335	61	154	55	29.159	275
Subject 77	F	10/27/04	1340	1392	64	172.6	69	29.689	52
Subject 78	F	10/28/04	1580	1655	66	220	47	35.583	75
Subject 79	F	10/28/04	1400	1749	64	240	27	41.282	349
Subject 80	F	11/2/04	1610	1484	59	168	36	34.003	-126
Subject 81	F	11/1/04	2170	1795	70	235	42	33.789	-375
Subject 82	F	11/1/04	1960	1684	66.5	225	53	35.847	-276
Subject 83	F	11/1/04	1260	1503	67	170	41	26.681	243
Subject 84	F	11/1/04	1120	1351	65	149	53	24.847	231
Subject 85	F	11/1/04	1510	1528	62.5	182.2	43	32.862	18
Subject 86	F	11/3/04	870	1255	64	114	28	19.609	385
Subject 87	F	11/2/04	1620	1640.2	66.5	232	69	36.962	20.2
Subject 88	F	11/4/04	1390	1547	63	202	52	35.858	157
Subject 89	F	11/12/04	1130	1332	64	150	61	25.801	202
Subject 90	F	11/18/04	1640	1775	68	234	28	35.654	135
Subject 91	F	11/30/04	1520	1752	66	244	41	39.465	232
Subject 92	F	12/2/04	1320	1519	66	198	67	32.025	199
Subject 93	F	12/2/04	1340	1557	66	197	52	31.863	217
Subject 94	F	12/3/04	1120	1300	62	143	50	26.210	180
Subject 95	F	12/8/04	1310	1477	67	195	51	30.605	167
Subject 96	F	12/8/04	1330	1532	65	185	39	30.850	202
Subject 97	F	12/8/04	1060	1273	64	132.8	52	22.843	213
Subject 98	F	12/9/04	1280	1495	61	187	32	35.407	215
Subject 99	F	12/9/04	1270	1417	65	170	57	28.349	147
Subject 100	F	12/14/04	1530	1864	65	280	51	46.692	334
Subject 101	F	12/14/04	1610	1806	62	267	62	48.937	196
Subject 102	F	12/15/04	1250	1404	60	175	52	34.249	154
Subject 103	F	12/15/04	1500	1750	67	242	47	37.982	250
Subject 104	F	12/28/04	1530	1522	67.5	196	72	30.308	-8
Subject 105	F	1/4/05	1570	1576	66	205	54	33.157	6
Subject 106	F	1/4/05	1730	1762	69	227	31	33.592	32
Subject 107	F	1/5/05	1520	1527	60	198	41	38.750	7
Subject 108	F	2/18/05	1700	1708	64	223	25	38.358	8
Subject 109	F	2/17/05	1310	1365	62	164.6	60	30.169	55

Subject 110	F	2/17/05	1150	1272	63	143	65	25.384	122
Subject 111	F	2/16/05	1240	1407	64	163	53	28.037	167
Subject 112	F	2/16/05	1200	1362	61	164	57	31.052	162
Subject 113	F	2/16/05	1520	1575	65	208	54	34.685	55
Subject 114	F	2/16/05	1500	1502	65.5	178	49	29.231	2
Subject 115	F	2/15/05	1310	1350	61	150	40	28.402	40
Subject 116	F	2/15/05	1300	1457	65	188	69	31.350	157
Subject 117	F	2/15/05	1240	1375	63	167	64	29.645	135
Subject 118	F	2/15/05	1520	1445	62	172	44	31.525	-75
Subject 119	F	2/10/05	1770	1954	66	309	56	49.978	184
Subject 120	F	2/8/05	1280	1180	60.5	111.4	42	21.443	-100
Subject 121	F	2/8/05	1180	1380	64	168	62	28.897	200
Subject 122	F	2/2/05	1770	1741	67	229	31	35.941	-29
Subject 123	F	1/7/05	1250	1468	62	180	44	32.991	218
Subject 124	F	1/7/05	1350	1315	66	140	58	22.644	-35
Subject 125	F	1/7/05	1360	1327	54	152	63	36.725	-33
Subject 126	F	1/7/05	1820	1817	70	250	45	35.946	-3
Subject 127	F	1/8/05	1510	1473	63	187.2	55	33.230	-37
Subject 128	F	1/8/05	1720	1665	69	218.6	52	32.349	-55
Subject 129	F	1/11/05	1310	1388	64	157	48	27.005	78
Subject 130	F	1/11/05	1410	1431	66	167.4	54	27.076	21
Subject 131	F	1/11/05	1610	1653	66	220	52	35.583	43
Subject 132	F	1/12/05	1400	1553	67	181	29	28.408	153
Subject 133	F	1/13/05	1830	1744	65	230	40	38.354	-86
Subject 134	F	1/13/05	1510	1846	72	251	41	34.113	336
Subject 135	F	1/15/05	1310	1328	65	154	74	25.681	18
Subject 136	F	1/18/05	1670	1590	67	194	42	30.448	-80
Subject 137	F	1/18/05	1330	1524	65	193	52	32.184	194
Subject 138	F	1/19/05	1310	1550	66	185	34	29.922	240
Subject 139	F	1/19/05	1370	1562	67	191	43	29.977	192
Subject 140	F	1/20/05	1620	1760	66	259	62	41.891	140
Subject 141	F	1/20/05	1900	1984	71	284.4	49	39.749	84
Subject 142	F	1/20/05	1900	1984	71	284.4	49	39.749	84
Subject 143	F	1/20/05	1620	1760	66	259	62	41.891	140
Subject 144	F	1/20/05	1430	1490	63	190	56	33.727	60
Subject 145	F	1/22/05	1370	1454	65.5	163	33	26.768	84
Subject 146	F	1/22/05	1900	1983	69	289.8	48	42.885	83

Subject 147	F	1/24/05	1480	1585	66	200	64	32.348	105
Subject 148	F	1/24/05	1720	1650	69	209	49	30.928	-70
Subject 149	F	1/24/05	1720	1822	72	244	41	33.162	102
Subject 150	F	1/25/05	1140	1232	62	122	62	22.361	92
Subject 151	F	1/25/05	1230	1370	63	155	44	27.514	140
Subject 152	F	1/25/05	1370	1450	63	183	41	32.485	80
Subject 153	F	1/26/05	1190	1316	62	150	36	27.493	126
Subject 154	F	1/27/05	1140	1272	62	145	68	26.576	132
Subject 155	F	1/27/05	1260	1517	68	189	54	28.797	257
Subject 156	F	1/27/05	1270	1620	63	221	63	39.230	350
Subject 157	F	3/2/05	1230	1422	64	179	61	30.790	192
Subject 158	F	2/26/05	1560	1700	71	213	37	29.770	140
Subject 159	F	2/26/05	1560	1772	65	267	61	44.524	212
Subject 160	F	2/26/05	1230	1385	65	170	69	28.349	155
Subject 161	F	2/25/05	1150	1349	60	159	50	31.117	199
Subject 162	F	2/25/05	1450	1470	67	170	48	26.681	20
Subject 163	F	2/25/05	1310	1370	62	160	50	29.326	60
Subject 164	F	2/24/05	1220	1388	63	164	54	29.112	168
Subject 165	F	2/24/05	1480	1497	61.5	186	39	34.648	17
Subject 166	F	2/24/05	1300	1426	64	180	69	30.962	126
Subject 167	F	2/23/05	1310	1556	65	203	58	33.852	246
Subject 168	F	1/27/05	1640	1998	66	300	58	48.523	358
Subject 169	F	1/28/05	1440	1573	69	195	56	28.857	133
Subject 170	F	1/29/05	1060	1200	60	133.5	57	26.127	140
Subject 171	M	7/7/04	1750	1886	68	225	61	34.283	136
Subject 172	M	7/9/04	1650	1876	71	218	61	30.468	226
Subject 173	M	7/13/04	1730	1836	68.5	222	68	33.334	106
Subject 174	M	8/3/04	1670	1874	73	205	51	27.103	204
Subject 175	M	8/3/04	1490	2361	71	250	24	34.941	871
Subject 176	M	8/9/04	1800	2195	76	230	19	28.055	395
Subject 177	M	8/10/04	2330	2250	69	245	32	36.256	-80
Subject 178	M	8/10/04	1620	1845	74	198	56	25.475	225
Subject 179	M	8/10/04	1900	2317	72	283	43	38.462	417
Subject 180	M	8/10/04	1770	1819	68	180	34	27.426	49
Subject 181	M	8/11/04	2640	3102	69.5	383	34	55.865	462
Subject 182	M	2/17/05	2210	2189	69	275	47	40.695	-21
Subject 183	M	8/17/04	2260	2332	72	300	42	40.772	72

Subject 184	M	8/18/04	2260	2236	74	266	41	34.224	-24
Subject 185	M	8/19/04	1900	1895	69	230	66	34.036	-5
Subject 186	M	8/25/04	1800	2062	71.5	250	55	34.454	262
Subject 187	M	8/25/04	2160	2478	76	336	63	40.985	318
Subject 188	M	8/27/04	2400	2466	73	303	16	40.060	66
Subject 189	M	9/7/04	2270	2170	71	238	41	33.264	-100
Subject 190	M	9/21/04	1320	1422	63	171	49	30.355	102
Subject 191	M	9/23/04	1800	1770	70	192	58	27.607	-30
Subject 192	M	9/23/04	1770	1940	68	200	20	30.473	170
Subject 193	M	9/24/04	1870	2002	72	250	69	33.977	132
Subject 194	M	9/28/04	2200	2196	74	277	56	35.639	-4
Subject 195	M	10/22/04	1520	1964	72	245	70	33.297	444
Subject 196	M	10/29/04	2080	2365	77	315	60	37.432	285
Subject 197	M	12/8/04	1500	1815	69.5	266	64	38.799	315
Subject 198	M	12/14/04	1320	1324	60	158	60	30.922	4
Subject 199	M	1/4/05	1700	1723	67	185.6	50	29.130	23
Subject 200	M	1/15/05	2210	2208	72	284	58	38.598	-2
Subject 201	M	1/24/05	1720	1934	71.5	231.6	65	31.918	214
Subject 202	M	1/25/05	1630	1750	67	178	62	27.937	120
Subject 203	M	1/25/05	1820	1939	75.5	216	46	26.697	119
Subject 204	M	1/26/05	1910	1986	72	260	66	35.336	76
Subject 205	M	1/26/05	1700	1827	72	200	47	27.182	127
Subject 206	M	1/26/05	1500	1740	69	188	54	27.821	240
Subject 207	M	2/23/05	1690	1970	68	240	51	36.568	280
Subject 208	M	2/26/05	1970	1922	68.5	235	62	35.286	-48
Subject 209	M	2/25/05	1850	2250	72	289	42	39.277	400
Subject 210	M	1/26/05	2120	2041	74	250	50	32.165	-79

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